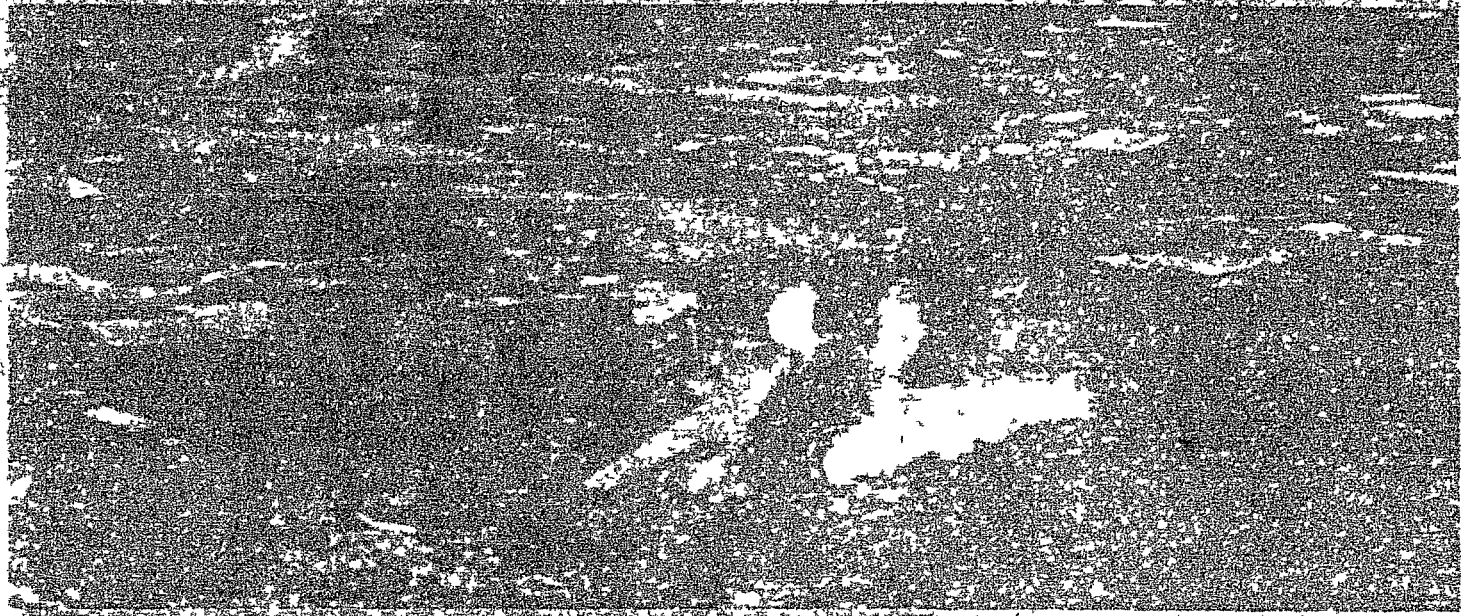
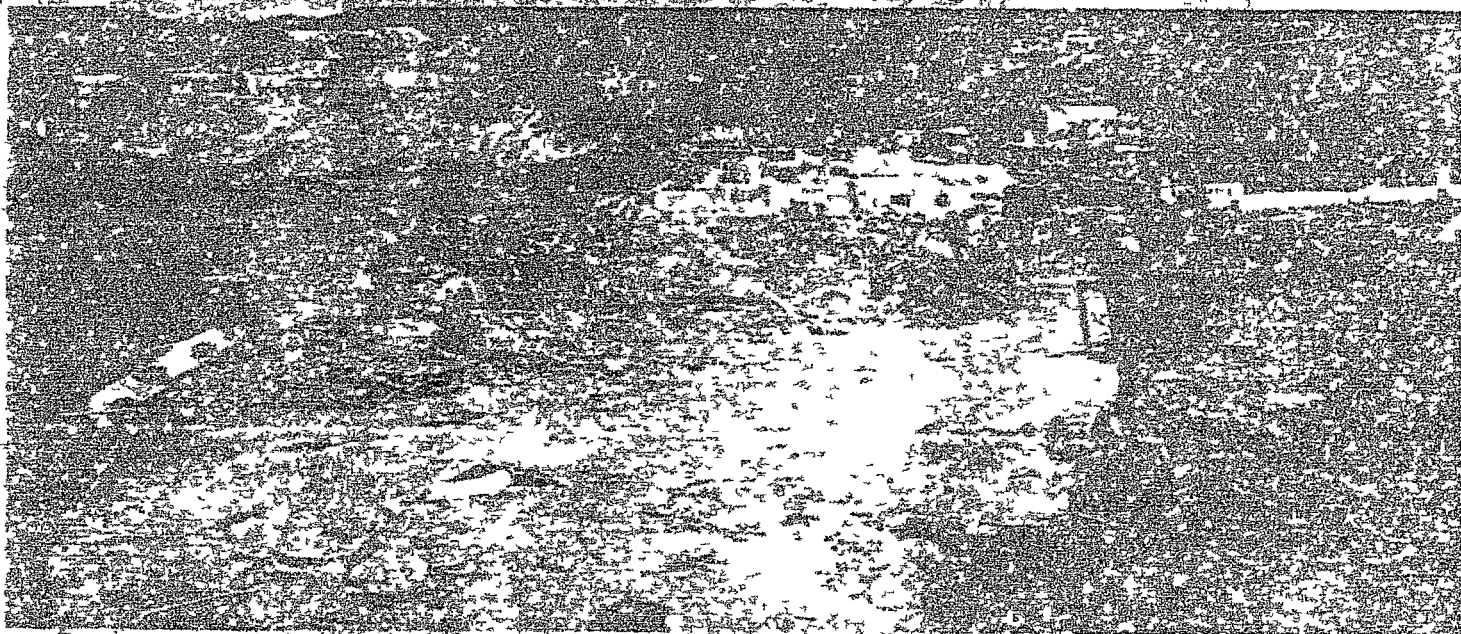


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HONDURAS: HURRICANE MITCH RECONSTRUCTION RECOMMENDATIONS

FINAL REPORT



U.S. INTERAGENCY TASK FORCE ON SHELTER AND
MUNICIPAL INFRASTRUCTURE

March 1994

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INTRODUCTION & EXECUTIVE SUMMARY

Purpose of Trip The Team's SOW was (1) the review of Mitch damage assessment in the shelter and infrastructure sector at national and municipal levels, (2) assist and advise USAID/Honduras on its emergency actions in support of municipal recovery and to explore options and to make recommendations on possible options to finding permanent shelter solution(s) to the temporary reception camps called "macro-alburgues" that are being built for families that have lost their homes (35,000) plus thousands of others whose homes must be abandoned are beyond repair or are located in precarious high-risk zones that are at risk in the next rainy season (3) define a strategy and policy framework to guide the direction and use of USG assistance to Honduran institutions and their U.S. partners, and (4) identify the respective assistance role of the Inter-Agency Task Force members and define an integrated Plan of Actions to be carried out for addressing priority problems in the short- and mid-term and to establish estimated cost of these activities

Inter-Agency Team Composition/Areas of Specialization

USAID/RUDO

- Jeff Boyer, Team Leader/Housing finance,
- Sonny Low, Municipal development,
- Phil Rourke, Housing finance,
- Chuck Van Fossen, NGOs-Housing design and production,
- Roger Cuernavaca, Housing construction and land markets,
- Roberto Carrilon, Housing policy and NGO partnerships,

HUD

- Carla Koppel, Oversight and policy direction,
- Ana Marie Argilagos, Community participation,
- Nelson Carbonell, Building systems and shelter design,
- Vernon Davis, Building materials, construction techniques and delivery systems,
- Felix Castillo, Building codes

USGS

- Jeff Phillips, Hydrological analysis
- Ed Harp, Geological hazards/landslides
- Bill Miller, GIS information systems
- Richard Moore, GIS information systems

CORPS OF ENGINEERS

- Mike Villadares, Supervisory oversight
- Roger Burke, Environmental land use planning
- Doug Otto, Hydrology engineering
- James Sanders, Geotech engineering

USDA

- Mark Hawthorn, Wood building technology

Statement of Principal Problems Hurricane Mitch exposed one of Honduras' most serious and long neglected social problems - lack of access to credit and home ownership by at least 70% of its population. The country's housing deficit is estimated at approximately 700,000 units, which means that the quality of the existing stock is severely overcrowded, of poor quality, and largely devoid of adequate basic services, and

Proposed Post-Mitch Reconstruction Program Components

In the initial and mid-term phases of the USG assistance program, the following activities are recommended for addressing priority problem areas related to the shelter crisis of the Mitch hurricane victims and other families that may require relocation due to their location in extreme high-risk areas that pose dangers of landslides or flooding in the next rainy season:

- Expand municipal infrastructure services & complete immediate critical watershed flood studies and hazard mitigation preparedness prior to next rainy season (May),
- Develop rapidly sites and serviced lots and provide building material kits for erecting temporary shelters by organized beneficiary groups,
- Provide complementary off-site sanitary and water services in support of developing new sites and service lots (where needed),
- Establish informal/formal finance channels for leveraging and disbursing credit funds for home improvement loans for self-directed construction of permanent housing by beneficiary families, and
- Provide technical assistance on both a bilateral mission basis and regional basis in support of short-term reconstruction objectives and mid-long term recovery goals

I UPDATE ON THE DAMAGE ASSESSMENT OF HURRICANE MITCH ON HONDURAS AND ITS IMPACT ON THE SHELTER AND MUNICIPAL INFRASTRUCTURE SECTOR

I A Storm Overview On October 24, 1998 tropical storm ' Mitch ' was upgraded to hurricane status and transformed itself into one of the strongest and most devastating storms to hit the Caribbean and Central America area since 1780, which killed approximately 22 000 people

At its height on October 26-27th Mitch reached Category 5 (highest level of severity), sustaining winds of 180 mph and dumping heavy rains on all the Central American countries. It was particularly devastating on the north coast of Honduras where Mitch stalled for several days causing catastrophic floods and destruction of thousands of homes, businesses, and rich agricultural lands. Although winds diminished, Mitch proceeded to march inland on October 30-31 in a south and westerly direction across Honduras ravaging destruction from flooding and landslides in the capitol of Tegucigalpa and other towns then exiting through southeastern El Salvador into the Pacific Ocean.

I B Mitch's Toll in Human Lives and Its Damage to Shelter and Municipal Infrastructure

	Initial Preliminary Estimates (November, 1998)	Current Estimates (February, 1999)
1 Dead	5,642	5,657
2 Missing	8,058	8,000-9,000
3 Injured	12,272	n/a
4 In Shelters	285,000	35,000
5 Homes Damaged (severely)	50,000	50,000
6 Total Affected	4,753,537	4,753,537
7 Country Population	6,203,188	6,203,188
8 Percentage Affected	76.6	76.6

Estimates of damage to local municipal infrastructure services including water, sanitation, bridges and roads, and electricity is on the order of \$58 million or more. Emergency services have been restored on a "provisional" basis to most municipalities, but cleaning, repair and/or replacement of damaged systems still remains to be done with financial assistance from external donors.

I C Contributing Factors to the Human Impact The untimely arrival of hurricane Mitch in the middle of the rainy season in Central America resulted in upwards of 5 feet of rain falling

on top of saturated lands and swollen rivers. The deadly effects of the hurricane were aggravated further by other man-made factors. The lack of watershed management, uncontrolled deforestation and incursion of human settlements into floodplains and other sensitive environmental areas that could act as buffers placed large numbers of people in extreme risk and vulnerability to deadly floods and mudslides. For lack of access to housing credit for which they could secure safe land sites and basic services, the poor majority of Honduras' population are left to fend for themselves, which results in their occupation often of marginal, high-risk urban areas where jobs and educational opportunities can be found nearby. Their precarious settlements are prone to steep slopes erosion, landslides, or floodplain areas subject to annual flooding.

II STATUS OF NATIONAL PLANNING ON MITCH RECONSTRUCTION & RECOVERY AND THE ROLE OF INTERNATIONAL DONORS

II A Presidential Commission for National Reconstruction To deal with the aftermath of Mitch's destruction, Honduras's president, Carlos Flores, created a National Reconstruction and Recovery Commission, consisting of key heads of ministries, to coordinate the country's immediate emergency disaster response and to prepare detailed assistance proposals for the upcoming Consultative Group meetings in Stockholm in May, 1999. Furthermore, a National Commission of the Reconstruction of the Shelter Sector was formed on November 5, 1998 with principal representatives of the following organizations – SOPTRAVI, FOSOFI, FONAPROVI, AMHON, RAP, CAHDEAP, CICH & INJUPEMP.

It is uncertain what is the level of Honduras's actual investments and planned financial commitments in the shelter and municipal infrastructure sectors, due to the team's limited presence in the country and its access to the National Reconstruction Cabinet during its short visit. However, it is clear that the GOH places a high priority on the rehabilitation and reconstruction of its basic infrastructure systems, particularly water supply and sanitation in its middle size cities. The shelter finance system and its policy framework is in critical need of reorganization as the housing deficit now exceeds 700,000 units.

II B Assistance Role of International Donors Among the principal IFIs working in Honduras' shelter and municipal infrastructure sectors are the Inter-American Development Bank (IDB), the U.S. Agency for International Development (USAID), and the World Bank (WB). The following summarizes their revised programs following hurricane Mitch.

a) **IDB** – It has approved regionwide \$160 million in new loans for Mitch reconstruction, municipal and social investment programs and is reprogramming an additional \$133 million in loans to finance road rehabilitation, energy infrastructure, hospital and school reconstruction, and epidemic control. Under its emergency program to Honduras, it will provide \$10 million for restoring drinking water service in Tegucigalpa. In addition, it is studying the possibilities of establishing a \$30 million subsidy facility for resettling of Mitch victims in temporary/permanent sites, and loan credits. It plans to implement a two-phased municipal modernization program in

San Pedro Sula for \$36 million covering upgrading of marginal neighborhoods privatization of solid waste services and rationalizing the city's urban growth

b) **USAID** - Using a combination of Mission and OFDA resources, an emergency reconstruction program was initiated after Mitch to repair damaged water supply and distribution systems in over 60 locations throughout Honduras. Estimated costs of these projects is \$2.3 million. In addition, it is financing the rehabilitation of 4 municipal sanitary sewage systems that were damaged. Cost of this construction is approximately \$230,000.

c) **World Bank** - It is making available \$100 million for emergency reconstruction to finance new operations in transport, roads, health, and social investment funds. Balance of payment support is forthcoming also from the World Bank (\$36million) and \$25 million from the IDB.

III ASSESSMENT OF MAJOR CONSTRAINTS

III A Principal Constraints for Emergency Relocation and Shelter Redevelopment

One of the most serious constraints for rapid and cost-effective implementation of emergency relocation programs for Mitch victims, as for the redevelopment of satisfactory solutions to meet the need for permanent shelter, is the **lack of a clear policy framework for assigning financial and operational responsibilities and authority in the sector** -- as between the national government, municipalities, PVOs and other elements of the private sector, and the decentralized agencies such as the centralized national water & sewerage and electric utilities that play a key facilitating/complementary role in shelter. *De facto*, municipal authorities have been obliged to assume first-line responsibility in providing a response to Mitch victims, but without specific emergency authority or financial resources to allow them to operate effectively. Lacking effective leadership or support from the central government in this area, the result has been that municipalities have had to improvise a great deal according to their own particular financial and organizational circumstances.

The effectiveness of the relief effort has accordingly been very mixed. Leadership at the national level is supposed to be provided by the National Reconstruction Commission and the Public Works, Transportation and Housing Secretariat (SOPTRAVI), but these entities lack depth in the shelter sector (SOPTRAVI continues to operate without an Undersecretary for Housing), and this has so far been reflected in their inability to yet develop a coherent and comprehensive shelter reconstruction strategy at the national level. Targeted technical assistance in this area for a period of six-months to a year would be of enormous value in developing such a strategy and establishing a framework to allow the various actors that need to participate in shelter reconstruction to perform their roles with greater efficiency.

A second constraint under the current Mitch crisis is the **lack of an adequate policy framework for housing finance**. The traditional formal sector housing finance system set up during the 1950s and 60s -- made up of specialized savings and loans associations operating with long-term refinancing from a centralized housing bank -- virtually collapsed during the high-inflation 1980s and early 1990s. Long-term refinancing for housing loans in Honduras is relatively scarce, being available to the banking system only from FONAPROVI and RAP, which are government entities set up to manage the pension resources of public and private sector employees, respectively. Little or no money is available for home mortgage lending any other than upper-middle and upper income families, and what money is available is priced at very high interest rates, currently in the range of 25-30 percent, which has a direct, substantial and negative impact on housing affordability. The lack of enough housing credit in the Honduran market is a major impediment to the self-help efforts of Mitch victims, especially the poorest among them.

A third key constraint is the **lack of well-informed, technically-sound land-use plans to guide urban redevelopment**. Hazard assessments and mapping are being particularly missed, and are a factor in slowing the selection of sites for emergency shelter redevelopment. To compound the lack of reliable information, municipal authorities have in general not been able or willing to adequately enforce whatever zoning regulations may be in place, with the widely observed result

being that low-income squatter families are in many places returning to the exact same sites that have just recently been destroyed by the hurricane, including on top of landslide material and along the same river embankments that just months earlier witnessed such widespread loss of life and property. With no resources and virtually no guidance from the public sector, these families simply have no other place to go.

III B Principal Constraints for the Redevelopment of Municipal Infrastructure

As in the case of shelter, a major problem is the **lack of clear delineation of responsibilities and authority**, as between the national government, decentralized national agencies such as the water authority, and local governments. At best, this situation contributes to needless delay in developing the plans and initiating the construction that is so urgently needed. At worst, critical needs go unmet because specific issues are allowed to fall through the cracks, or the project development process is seriously distorted by the interjection of interagency rivalries and political considerations into the decision-making process.

Comprehensive hydrologic and engineering data and analysis are sorely needed to guide reconstruction efforts. Much effort and money will be wasted if local infrastructure works – particularly works such as levees intended to protect local populations from future natural hazards – are undertaken without an adequate understanding of the basin-wide interactions that within a hydrological system that can totally negate the effectiveness of local works, or simply result in the displacement of a natural hazard from one location to another.

Adequate project management and implementation capacity, including the ability to contract and supervise the private sector, is sorely lacking at both the national and local levels. Because a dynamic housing delivery system is not flourishing, key institutions are not geared up to respond to the housing needs situation – some delays to do so may be expected. Furthermore, without adequate supervision in the sector both national and local agencies have been victimized by unscrupulous operators in both the public and the private sectors.

Clearly, the **lack of adequate financial resources is a key impediment** to infrastructure reconstruction, especially at the municipal level. The disaster has had a huge impact on the current expenditures of local governments, which have had to bear the brunt of emergency relief services being provided to displaced populations throughout the country. At the same time, local revenues have been hard hit, as large numbers of both individuals and businesses in damaged areas have found themselves unable to keep up with scheduled tax payments. Many businesses and properties have been destroyed, while others, including such major industries as the banana plantations in northern Honduras, face a highly uncertain future due to the long-term aftereffects of hurricane Mitch.

Finally we would draw attention to the **lack of capacity to identify, develop and formulate infrastructure investment projects at the local level** as another major redevelopment constraint. Even if resources are available, resources will not flow to the highest priority uses unless the project development and appraisal system is adequate to generate the quality of information that is needed to guide the resource allocation process. Organizations such as FUNDEMUN are working hard to assist municipalities to overcome their deficiencies in this area but more needs to be done to adequately respond to the emergency nature of this crisis.

IV PROPOSED RECONSTRUCTION PROGRAM IN HOUSING AND MUNICIPAL INFRASTRUCTURE FOR HONDURAS

IV A Reconstruction Objectives and Policy Framework

The Housing and Municipal Infrastructure Reconstruction Program described below is intended to provide an overall framework to organize the response of a variety of U.S. Government agencies seeking to assist Honduras to recover from the impacts of Hurricane Mitch on that nation's housing and infrastructure stocks. With almost 50 inches of rainfall between October 27 and November 1, 1998, Mitch resulted in massive flooding and landslides that are estimated to have destroyed approximately 35,000 homes and seriously damaged 50,000 additional housing units. Supporting infrastructure in many cities and towns including bridges, roads, culverts, storm drains, water and sewage systems throughout the country also suffered extensive damage or destruction.

The proposals outlined below are framed in consideration of the following major policy objectives:

- Take immediate actions to provide rapid relief to families left homeless or those still exposed to imminent high risks due to natural hazards (landslides and flooding),
- Provide "gap-filling" assistance to alleviate bottlenecks and provide missing resources to complement those already available from the GOH, other donors, and/or international PVOs/NGOs,
- Support to municipalities and other local organizations that are on the frontlines of hurricane relief and hazard mitigation work,
- Make maximum use of existing USAID programs and institutional arrangements to minimize implementation problems and delays, and
- Take initial steps at the outset of the reconstruction program to minimize policy conflicts with USG long-term interests to ensure that our assistance produces "real, enduring progress for the people of Central America." In the housing and infrastructure sector this would translate into a set of reconstruction actions that avoids distorting existing housing and municipal finance systems. Our actions should seek, wherever possible, to strengthen the roles and capabilities of local governments and private sector institutions.

to work in partnership for achieving in the mid-long term adequate delivery of shelter and urban services on a sustainable basis. Thus, our efforts ought to target not only Mitch affected low income families, whose homes were lost or severely damaged, but also lay the groundwork for the country to attend the long neglected housing deficit problem.

IV B Outline of Principal Proposed Program Components

The proposed Sector Reconstruction Program should consider the following five (5) principal components:

<u>Program Component</u>		<u>Proposed Funding Levels</u> (US\$ millions)
1	Expanded Municipal Infrastructure & Hazard Mitigation Program	40-80
2	Emergency Sites and Services Grants For Relocation Of Homeless Families	20
3	Complementary Off-Site Infrastructure Services	5-10
4	Revolving Home Improvement Loan Fund for Mitch Victims & Low-Income Families	25-50
5	Technical Assistance	3-5
<i>Total</i>		93-165

Component 1 Municipal Infrastructure & Hazard Mitigation This is an extension of USAID/Honduras' ongoing support to a number of municipalities that are undertaking reforms to enhance citizen participation, strengthen financial administration and improve the quality of urban services. USAID has provided grants for the construction of necessary urban infrastructure in such municipalities, with construction design and supervision provided by a special unit of FHIS, and within the context of a financial program designed to assure cost recovery by the municipal grantee.

In response to the damage caused by hurricane Mitch, the proposed expanded program would provide USAID with additional resources to carry forward this work, and allow it to expand coverage to include disaster preparedness, emergency hazard mitigation activities that are suitable for implementation at the municipal level, such as, for example, local dredging and construction of levees, repair and cleaning of existing water, sanitary and storm drainage systems, new infrastructure improvements to support housing reconstruction requirements, etc.

Component 2 Permanent Relocation Sites & Service Grants is designed to complement the ongoing work of GOH and municipal agencies, other donors, international and domestic NGOs and the other USAID programs described above in providing direct near-term assistance to the very poorest of the poor who are presently homeless or in immediate danger of becoming homeless.

In the days immediately following Mitch, about 285,000 people were forced to seek emergency shelter. Almost three months later, approximately 30,000 people without financial means and with nowhere else to go are still left in emergency public shelters throughout Honduras. Many of these shelters are rapidly converted public schools that need to be evacuated to allow the new school year to begin on time on February 15, 1999.

With assistance from the Organization for International Migration (OIM) and OFDA, the GOH of Honduras is building emergency shelter complexes ('macro-albergues') to provide a transitional solution during the next year while more permanent housing is provided for this hard-core group of essentially destitute hurricane victims.

Added to this group, a perhaps similar number of people is expected to become homeless in the near future, either as a result of mandatory removal from sites that are in imminent danger of landslides or flooding, or as new victims are created by the onset of the coming May-November rainy season among families that are not removed from unstable areas in time. The majority of these people, who continue to live in high-risk areas which were made more unstable by Hurricane Mitch, are extremely poor.

Some of these people will be provided with a permanent housing solution through NGO or other donor-financed programs during the next several months. However, it is estimated that as many as 10,000 families will not have found another permanent solution within a four- to six-month time frame and there is a significant danger that these may or could become permanently dependent on "transitional" barracks-type housing with shared amenities unless an alternative solution is found. Experience with such "transitional" solutions in other countries following similar disasters points to the dangers of increasing dependency, deteriorating sanitary and social conditions, high crime rates and a potential for violent political action from people who are forced for lack of any viable alternatives to live in overcrowded barracks for more than just a very brief period of time.

Most of the people who will be going into these barracks, or "macro-albergues", had only very rudimentary housing prior to the hurricane, in many if not most cases, without even having had title to the land they occupied. Specific interviews conducted with occupants of temporary shelters, and prior experience in other countries both indicate that what such families seek most in these circumstances is just the opportunity to have secure possession of a small piece of land in a safe place not too far from work -- provided with very basic water and sanitary services if possible -- where they can gradually build out their own shelter over time, according to their own individual needs and financial capabilities.

In order to effectively counter the otherwise very real threat of institutionalizing a permanent barracks population in Honduras — especially the capital city of Tegucigalpa that has the largest number of homeless and the greatest population at extreme risk from renewed landslides and floods during the upcoming rainy season — the Interagency Task Force on Housing and Municipal Infrastructure recommends funding an emergency sites and services program to be tightly-focused on the up to 10,000 families who may still be homeless and other families vulnerable to new life-threatening disasters within the next six-nine months time frame. This population which is self-limiting and can be very precisely defined, includes

- families who will, for lack of any better alternative be forced within approximately the next month to move into the transitional barracks, or macro-albergues which are currently under construction,
- families who will be required by municipal authorities to abandon their homes some time during the next 3-4 months before the onset of the next rainy season, because they are located in hazardous locations, and
- families who are missed by preventive actions such as described above, and who become new victims of landslides or flooding with the onset of the new rainy season

Given the extreme poverty of this narrowly-delimited target group and the urgency of their plight, it is recommended that USAID organize a program to facilitate their access to a minimally-serviced plot, with clear title and less subject to natural disasters, as soon as possible but not later than within the next 6-12 months. The typical package to be provided as a grant to the families falling into one or the other of the categories previously described would include the following, and is estimated to cost between \$1,400-2,000 depending principally on location, with Tegucigalpa having the highest land prices and most difficult and expensive conditions for urbanization

<u>Sites & Services Component</u>	<u>Estimated Cost</u> (US\$)
- 6 m x 12 m plot, plus access,	150-750
- Water & basic sanitary connection	750
- Concrete slab, 20 m ²	250
- Materials package for walls & roof	<u>250</u>
Total	1,400-2,000

The most rapid and flexible way of organizing the delivery of minimally-serviced sites to this relatively small group of perhaps 10,000 extremely indigent hurricane victims is to issue non-transferable vouchers or certificates to them which can be endorsed by them to any pre-qualified developer/housing NGO of their choice in exchange for delivery of a site at their preferred location. A financial entity/fund administrator, perhaps the same foundation that could be set up to manage the revolving home improvement loan fund described above, would receive endorsed certificates from developers/housing NGOs and other qualified "demand organizers", verify the authenticity of the certificates against a master list of beneficiaries, inspect the serviced site chosen by each group of beneficiaries to make sure that minimum standard conditions are met,

and disburse USAID grant funds to reimburse the developer on delivery and transfer of title of the serviced lot to the beneficiary

Beneficiaries having the financial means to do so would also be eligible for a home improvement loan to allow them to enlarge or improve on the basic solution made available to them through the USAID emergency grant program. Alternatively, beneficiaries would also be entitled to apply their voucher towards the purchase of a slightly larger more finished dwelling that provides affordable complementary long-term financing to allow some of these families to acquire more than just the minimum serviced site solution if they can afford it.

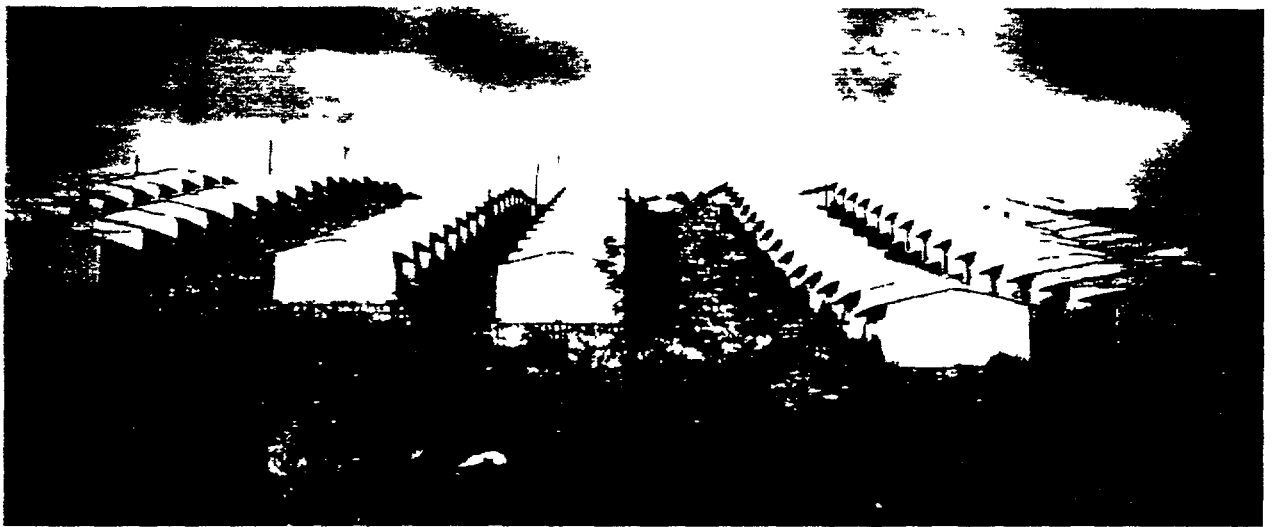
Utilizing the voucher system will allow the Honduran for-profit and not-for-profit private sector to participate fully in the acquisition of suitable private land and the development of adequate minimum solutions for this especially hard hit group of hurricane victims. Equally important, this system ensures maximum choice to beneficiary families to choose their preferred location of their future home. In contrast with large-scale projects built by the public sector to provide uniform permanent housing to this population, a demand- and market-driven approach to selecting sites and providing solutions is much more likely to result in the development of smaller but more stable communities, better located to suit individual families' needs with regard to earning their livelihood, and more flexible in terms of providing a range of alternative solutions priced according to individual tastes and incomes.

If the grant program is focused strictly on the target populations defined above, identification of beneficiaries will be a straight forward matter that, unlike other programs being developed by some international NGOs and other donors, is not likely to distort the reconstruction process by contributing to the formation of unrealistic and unaffordable expectations among hurricane victims. A maximum of flexibility and speed of response will be made possible by allowing the participation of a large number of private NGOs and developers who can produce a wide variety of smaller and more diverse projects to more closely meet the varying needs of different subgroups of beneficiaries.

The proposed sites and services approach is also likely to cost significantly less than major new developments in outlying areas if, as is expected, smaller-scale developments can be undertaken within easy reach of existing truck lines (water & sanitary) and will not require major off-site extensions of water and sewer lines.

Component 3 Complementary Off-Site Infrastructure will most likely be required in assisting in the provision of permanent housing sites for the approximately 10,000 homeless families. To bring water and sanitary services to the selected sites to be developed into urbanized lots, it is estimated that an additional level of grant assistance may be required, in some cases, may be required for off-site infrastructure expansions and/or improvements to be built. For example, it is known that the two sites owned by the Municipality of Tegucigalpa that are being considered for emergency development (El Ingles and Las Trancas), both will need substantial off-site investments to complete access roads and provide the sites with water, sewer and electricity connections. Both sites together would cost about \$6 million for off-site infrastructure, and would provide approximately 4,000 solutions at an additional onsite infrastructure cost of about \$1,000 per lot.

Option The Task Force recommends that the USAID Mission consider requesting for the Corps of Engineers to perform a quick evaluation of alternative sewage treatment options to alleviate the possible negative environmental impacts of utilizing the unoccupied INJUPEMP housing development at Ciudad Mateo on the outskirts of Tegucigalpa. Three thousand two hundred small 0, 1 and 2 bedroom units were finished almost six years ago by this government employees' pension fund and have been left unsold and empty for a number of reasons including alleged malfeasance but principally because of the site's location above a potable water reservoir called Los Laureles and objections raised by local environmental action groups. If a sound technical solution can be found -- perhaps involving the construction of a small sewage treatment plant onsite and piping the treated effluent to a point below the water reservoir -- it is likely in view of the dire emergency brought on by Mitch, that solutions can also be found for the legal, financial and political aspects of the problem.



Thousands of empty housing units at Ciudad Mateo

This might be a way to very rapidly accommodate 3,200 homeless families at a cost probably less than \$1 million in incremental investments for the above-mentioned sewage treatment system. INJUPEMP has another large, unsold project in San Pedro Sula, and IMPREMA (the teachers' pension fund) has another in Tegucigalpa, both of which should also be investigated quickly to determine if they can be brought into a rapid response solution for low-income families within the next few months.

Finally, the sites and services alternative recommended by the Task Force as another option for providing a minimum solution to low-income families is also likely to require some support in the form of financing for off-site infrastructure. It is difficult to estimate how much will be needed until we can develop a better estimate of how large the sites and services component will be, and what suitable locations in Tegucigalpa and in other cities will be brought forth for development by market forces. It is expected that off-site infrastructure development needs for this option will be relatively small -- because the sites are likely to be located in closer proximity to existing water and sewer mains and because the sites will themselves be relatively small. Rather than developing two to four thousand units at a single site, as would be the case with either of the two other options cited above, the private market is more likely to bring forward sites in the 100-200 unit size range, interspersed among other already developed and occupied sites. Still, some provision for off-site infrastructure extensions must be made even if this

becomes the predominant solution type. Any excess funds not expended on complementary off-site infrastructure can be added to the revolving home improvement loan fund if necessary after a two- to three year period.

Component 4 Revolving Home Improvement Loan Fund would, through a local grant or cooperative agreement, provide resources for onlending to credit unions, credit NGOs and other suitable financial intermediaries who have a demonstrated capability to serve low-income families in selected areas of the country. Revolving loans to these specialized intermediaries would be provided by the grantee at positive real rates of interest and for a three-to-five year loan period. In an effort to leverage additional funding for these specialized intermediaries from commercial banks and other formal sector financial institutions (risk-sharing), the grantee would accept the subordination of its loans with respect to other funds obtained from commercial sources. Participating intermediaries would then be required to on-lend a multiple of the USAID funds to low-income families requiring credit for shelter repairs, expansions or improvements, with that multiple perhaps growing over time.

Home improvement loans will be provided to low-income borrowers without regard to tenure status and with non-mortgage forms of security when necessary. Loans will not be available for families residing in areas designated as high-risk by municipal authorities, but would otherwise be available to Mitch victims as well as other low-income families requiring access to credit on non-subsidized terms. First-time borrowers would be limited to a maximum of something like the equivalent of US\$500 to be repaid in not more than two years. Borrowers successfully repaying first-time loans would become eligible for progressively larger amounts and longer repayment periods, at the discretion of the specialized lender in accordance with their own established credit policies and practices. Home improvements undertaken to improve the physical safety, sanitary conditions and/or income-generating capacity of low-income dwellings would be specifically targeted.

The demand for small, short-term, revolving home improvement loans by low-income families in Honduras is expected to far exceed the resource levels recommended for the proposed USAID grant. As noted above, Hurricane Mitch is estimated to have destroyed 35,000 homes in Honduras, and to have caused significant damage to some 50,000 other dwellings. These numbers are in addition to a pre-existing housing deficit estimated at some 700,000 units, generated largely by massive overcrowding and the widespread prevalence of substandard construction in low-income communities throughout the country. The availability of USAID funds to credit unions, credit NGOs and other lenders serving low-income communities will make it possible for families to make urgent repairs that are necessary to recover from Mitch, and gradually improve the safety, healthfulness and quality of their homes in accordance to their individual needs and financial capabilities.

Adequately meeting the long-term needs of all low-income families in Honduras will, however, require that formal sector financial institutions increasingly participate in this market, either as direct lenders, or, more likely, as sources of finance for specialized intermediaries that are able to extend and recover small loans at low cost. It will therefore be necessary from the outset to emphasize mechanisms, such as described above, that are able to leverage increasing amounts of private commercial funding for this sector and to ensure sustainable long-term recovery.

Properly managed, the \$50 million proposed USAID grant would serve to capitalize a permanent and growing revolving fund to help meet the needs of Mitch victims and other low-income Honduran families. In view of the desired permanence of the home improvement loan fund, it is recommended that a special-purpose foundation or a fiduciary trust be established to serve as the USAID grantee. As shown by the Municipality of San Pedro Sula in organizing its response to Mitch, it is possible to organize a private foundation expeditiously when necessary. As compared to the other existing option of establishing a cooperative agreement with a single NGO to manage the USAID grant funds, organizing a special-purpose foundation would allow for much broader participation of a variety of institutions able to contribute to the development of home improvement credits for low-income families in Honduras, and reduce the exposure of the program to potential mismanagement or disruption arising from a change in the particular circumstances of any single organization. Specialized housing NGOs, as well as credit NGOs, banks and other private and public sector organizations would, of course, be encouraged to join and participate in providing policy direction and oversight for the management of the proposed foundation.

Component 5 Technical Assistance Finally, it is proposed that adequate provisions be made to support technical assistance and training for various groups who will be asked to make a contribution to the emergency reconstruction program. This technical assistance and training has not yet been scoped out in detail at this stage. However, we anticipate that it will need at minimum to include the following elements:

- TA to credit unions and credit NGOs in adapting their current loan instruments and policies to lending for progressive housing construction and improvement. For example, entering into this market may require micro-enterprise lenders to slightly extend the recuperation period of their loans, up to two or three years, and this would, in an unstable inflationary environment, justify their use of some kind of graduated or indexed payment system that they may not have used yet. Principal supported would be recommended through RUDO/G ENV SUM contract mechanism.
- TA to municipalities - is recommended in the short term in two primary areas – (1) disaster preparedness (civil organization) and (2) flood mitigation action plans. In the mid-term local and regional (watershed) land-use planning, investment project analysis and the design of appropriate incentives and disincentives to indirectly influence private sector development activities in housing and employment are critical.
- TA for national policy dialogue, it may well be productive for USAID to sponsor a series of policy studies in the area of housing finance and infrastructure-urban land markets in Honduras, to provide guidance for addressing the more intractable structural factors that have so far and other areas thwarted efforts to develop a large-scale and inclusive housing finance system. Key issues include:
 - The role of public sector borrowing in distorting the term structure of interest rates and in crowding out private sector demand,
 - financial market liberalization to allow the more widespread use of more flexible and inflation-tolerant savings and lending instruments,
 - development of contractual savings institutions able to support a national or

- regional secondary home mortgage market
 - risk factors affecting costs and factors limiting competition in the Honduran financial markets
- Technical Management Support to Honduras Mission To assist the Mission in jump-starting the development of sites and service lots, any activities related to off-site infrastructure services, and follow-on home improvement loan activities both G/ENV UP and the RUDO/CA offices offer to assist in preparing related operational program designs, contract preparations, evaluation of housing proposals from developers/NGOs, monitoring of construction supervision/project completions and delivery of finished lots (sites and services) to beneficiaries

PRINCIPAL COMPONENTS OF THE USAID/HONDURAS EMERGENCY HOUSING PROGRAM				
Component	Elements	Estimated Unit Cost US\$	Target Population	Implementing Agency
I Serviced Lots	1 150 v2 lots 2 Min services 3 20 m2 slab 4 Materials package Social infrastructure (e g schools)	1 150-750 2 750 3 250 4 250 Total Up to \$2 000 grant evidenced by certificates	Intilling among displaced and at-risk populations (approx 30 000 in albergues plus at-risk population less other funded commitments, provision for 10,000 solutions at \$2 000 each)	U S - Honduras Mitch Foundation or suitable housing NGO
II Complementary Off-site Infra- structure	Will vary relatively insignificant for close-in locations	Will vary, GOH agencies expected to contribute, grants for municipalities	as above	Appropriate GOH or municipal agencies
III Short- Term Home Improvement Loans	1 Organization & training 2 Partial funding 3 Partial support for guaranty fund	US\$300-500 for up to two years at market rates	Mitch damnificados and low-income population at large	1 Credit unions 2 Micro-enterprise lenders
IV Technical Assistance	1 TA for institutional development, e g self-regulation, savings mgmt , guaranty pool 2 Product development, e g graduated payments 3 Regulatory reform	To be determined	Low-income urban population through specialized micro- credit organizations & financial institutions	1 NGOs (e g ASEPADE, FUNADEH, ODEF, COVELO, FINCA, etc) 2 Commercial banks
V Expanded Municipal Infra-structure & Hazard Mitigation Program	Will vary by municipality & site	Will vary, generally requiring grants for affected municipalities	Municipalities	Municipalities/FHIS

V IMPLEMENTATION STRATEGY

Institutional and Management Considerations

As was previously indicated, a principal policy objective guiding the development of an implementation strategy for the Mitch reconstruction program in Honduras is to build on existing USAID Mission programs as much as possible and otherwise ensure that — except perhaps in the very short term — the additional burden on Mission management and resources is kept to an absolute minimum.

Thus, it has been recommended that Component 1, Municipal Infrastructure and Hazard Mitigation, be conceived of as largely an extension of the Mission's ongoing municipal infrastructure development activities, which are being implemented as part of its broader democracy and decentralization program. With the exception of the proposed hazard mitigation sub-component, municipal infrastructure development activities will expand in number and dollar value but not in nature, and can be implemented through existing agencies, i.e., the municipalities, FHIS, AMHON and FUNDEMUN. It may be necessary to recruit additional host country engineering and construction management specialists to assist in the implementation of an expanded program, but additional direct hire staff will probably not be necessary.

The proposed hazard mitigation component would build on existing in-country Corps of Engineers staff resources, supported by short-term specialists from the Corps of Engineers, USGS, OFDA, RUDO and HUD/FEMA brought in on short-term assignments. Again, management of the proposed program should not require any permanent expansion in direct hire staff, though some additional local support may be required. Collaborating entities for this program will include the National Resources Secretariat at the national level, and individual municipalities and FUNDEMUN at the local level.

The recommended approach for the implementation of Components 2, 3 and 4 (Revolving Home Improvement Loan Fund, Emergency Sites and Services Grants and Complementary Offsite Infrastructure, respectively) is the organization of private, not-for-profit Honduran foundation to serve as grantee and provide ongoing coordination and management as required. As has been demonstrated in San Pedro Sula, where the municipality chose to establish a new foundation as a vehicle for implementing its emergency housing program, it is possible to organize such an entity under Honduran law without undue restrictions or delays.

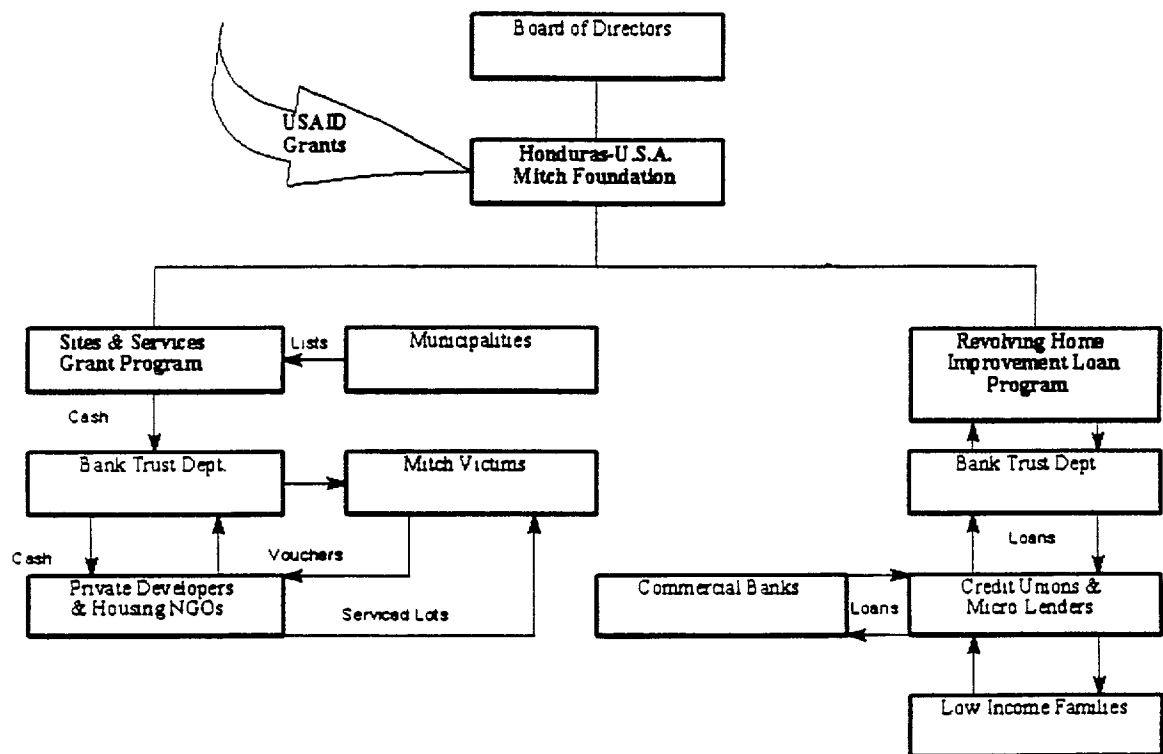
Membership in the proposed U.S.-Honduras Mitch Foundation could include entities such as the following, for example, among others:

- USAID
- AMHON
- Fundacion Coveló
- FACACH
- PRIMHUR
- CHF
- AHIBA

The functions of the foundation would include

- In the short run, oversight and disbursement of the proposed Emergency Sites and Services Grants and associated Complementary Offsite Infrastructure programs utilizing the mechanisms that were described in Chapter 4 and
- On a continuing basis, managing the (second-story) financing operations required to channel recover and continually recycle USAID grant resources through a network of credit unions, micro-finance NGOs and other specialized intermediaries to provide partial funding for a growing portfolio of revolving home improvement loans for Mitch victims and other low-income families throughout Honduras

In carrying out its functions, it would be expected that the proposed foundation entity would contract the services of reputable private financial institutions such as RAP or one of the large commercial banks to hold funds, assist with record keeping, and maintain the necessary financial controls to ensure honest and efficient financial administration of the resources entrusted to the proposed foundation. The schematic diagram presented below illustrates the simplicity of the proposed implementation arrangements



Organizational Schematic for Implementation of Honduras Shelter Program

The establishment of a new, specialized foundation was recommended for the following reasons

- the foundation would be and be perceived to be a Honduran institution,

- the foundation would be less likely to encounter conflicts-of-interest precisely because it would be set up as a special purpose entity with a narrowly-defined set of functions organization of the foundation can be more flexible and inclusive ensuring the participation of all the right Honduran organizations in policy development and program oversight and management, and
- as a diverse and independent entity able to adapt its structure and membership in a changing environment in response to its specialized functions and needs, the foundation is less likely to be subject to being permanently affected by organizational or financial problems outside of its own structure or outside of Honduras itself. A strong and qualified NGO can not provide the same assurances that it will remain strong and qualified indefinitely into the future, and could conceivably easily be affected by problems arising elsewhere among its international affiliates or parent

Other alternatives to establishing the proposed foundation could include (1) establishing a fiduciary trust arrangement with a Honduran financial entity, (2) entering into a cooperative agreement with a qualified international housing NGO with a track record in the management of low-cost emergency housing programs overseas, or (3) a combination of the above to management particular components of the recommended shelter program

Immediate Next Steps

The three most critical steps that need to be taken to move forward rapidly with the proposed Mitch reconstruction program are

1. Implement an agreement with the USGS/Corps of Engineers even if only on an interim basis until a longer-term agreement can be structured once supplemental funding levels are known. Time-critical activities needing support from these two agencies include
 - Completing key watershed management studies and flood mitigation plans as well as hazard assessments and site maps for municipalities that have identified populations living in high risk hazardous areas. A recent preliminary estimate for Tegucigalpa, conducted by the Planning Office of the Municipality with the assistance of one of the Interagency Task Force consultants, indicates that about 1,270 occupied housing units in the capital city are in areas of extreme risk and that as many as 4,000 units (and the families that occupy them) are at either an extreme or a high risk. Clearly, it is vital to complete and further refine these estimates so that appropriate preventive measures can be taken before the onset of the next rainy season in May.
 - It is important to make a decision to proceed or not on evaluating possible use of two existing housing projects. We believe it to be critical for the Corps of Engineers to contribute to the preparation of an Environmental and Financial Appraisal of the INJUPEMP and IMPREMA housing projects in Tegucigalpa. The former is a project (also known as Ciudad Mateo) which contains approximately 4,000 virtually completed housing units, including onsite water, sanitary and electrical infrastructure, that have been sitting unsold and empty for something like 5 or 6 years.

The original issue apparently blocking sale and occupancy of these units (which include 3,200 Abasic@ units and some 800 units obviously intended for a middle- or upper-middle class market) was apparently their location. The site of Ciudad Mateo is in the watershed of the Guaserique River, and at a point located about 2 km above the Los Laureles potable water reservoir. Clearly, there is an implicit environmental health risk if sewage from this development were allowed to contaminate an important source of potable water for the city. However, there may well exist technically and financially acceptable engineering solutions to counter this potential environmental threat. For example, it might well be possible to install a small primary treatment plant at the site, and then to pipe the treated effluent for disposal into the Guaserique River at a point below the Los Laureles reservoir. In the extreme emergency conditions currently being faced by Mitch victims in Tegucigalpa today, it is certainly worth a rapid assessment C which, it has been estimated, could be completed by a team of 4 Corps of Engineers.

specialists in about one week to determine if an environmentally sound solution can be found which would make these basic units rapidly available for occupancy by homeless families

Developing a strategy for making the INJUPEMP project available for relocation of Mitch victims assuming that an acceptable engineering solution is found would also require the services of a financial advisor to assist the Government of Honduras INJUPEMP and the builders in working out an acceptable financial arrangement to allow these units to be made available rapidly

The IMPREMA site is located a little closer to the center of Tegucigalpa, also along the banks of the Guaserique River Here, about 2,000 modest dwelling units built by the teacher's pension fund also stand empty and unsold It is not clear whether these units could be safely occupied, as the river banks at the site were extensively scoured by the Mitch floodwaters and a major retention structure was badly damaged However, this is an issue that Corps of Engineers specialists could quickly evaluate, perhaps pointing towards a solution that would bring an additional large number of homes rapidly onto the market

2 Organize U S Honduras Mitch Foundation

As has been indicated above, there are many reasons for preferring a special-purpose private foundation as the vehicle for implementing the proposed Emergency Sites and Services Grants program, and the complementary Revolving Home Improvement Loan Fund The organization and legal establishment of the foundation requires that a decision be made, so that the legal and organizational development work of actually bringing it into being can proceed

3 Develop detailed organizational and implementation plans for

- Emergency Sites and Services Grants program, including Complementary Offsite Infrastructure development, as needed
- Revolving Home Improvement Loan Fund

Having selected a vehicle for implementation of these proposed reconstruction program components, the logical next urgent step becomes that of developing detailed implementation plans for each Consultants who participated in the Interagency Task Force for Housing and Municipal Infrastructure in Honduras have already prepared some preliminary proposals for organizing the implementation effort operationally, and these materials will be made available under separate cover at the appropriate time

VI ESTIMATED BUDGET

As has been previously indicated in various areas of this report the proposed shelter and municipal infrastructure program would consist of the 5 main components identified below listed in order of the size of the proposed financial commitment by the U S Government to each

<u>Program Component</u>	<u>Proposed Funding Level</u>
1 Expanded Municipal Infrastructure & Hazard Mitigation Program	US\$40-\$80 million
2 Revolving Home Improvement Loan Fund for Mitch Victims & Low-Income Families	\$25-50
3 Emergency Sites and Services Grants	\$20
4 Complementary Offsite Services	\$5-10
5 Technical Assistance	<u>\$5-10</u>
Total	US\$95-170 million

In the view of the Interagency Task Force, the appropriate level of funding for the proposed program in Honduras is the higher figure of \$170 million. The derivation of the components of this estimate and its justification are described below. If budgetary constraints limiting the size of the supplemental appropriation finally approved by Congress were to put this figure out of reach, we would then propose a proportional reduction in all of the proposed program components except for the Emergency Sites and Services Grants which need to remain close to the proposed \$20 million funding level in order to achieve the required impact.

Component 1 Expanded Municipal Infrastructure & Hazard Mitigation Program

The estimated funding requirement for this program component is derived from USAID Mission estimates presented to the LAC Bureau in the context of developing the supplemental appropriations request. In that presentation, the Mission identified infrastructure reconstruction and expansion needs totalling approximately \$60 million. To this amount has been added another \$20 million which would be made available to support hazard identification, hazard mitigation and disaster preparedness activities throughout the most seriously threatened regions of the country.

Component 2 Revolving Home Improvement Loan Fund

Potential demand for small home improvement loans originates from the following groups of low-income families

a	Mitch victims (35,000 destroyed - 50 000 damaged) units	85 000
b	Housing deficit (overcrowded/substandard -700 00 units)	Total 785,000

Effective annual demand for loans during the next few years will obviously be a subset of the above which can not be measured precisely before the program enters into operation. However, the following operating assumptions provide the basis for a preliminary estimate

a	1 in 3 Mitch victims (families)	28 333
b	1 in 8 housing deficit families	<u>87 500</u>
	Total borrowers	115,833
Times,		
	Average loan size	\$500
	Equals, annual loan volume	\$58 million (approx)

Component 3 Emergency Sites & Services Grants

A similar approach can be taken in estimating the need for emergency sites and services grants. We begin by estimating the total number of very low-income families needing emergency relocation, as follows

a	30,000 people in macro-albergues ¹ , at 4 people per family, assuming higher proportion of single women, single mothers with children, and elderly than population at large	7,500
b	30,000 people to be relocated from hazardous sites throughout the country, at 5 per family ¹	6,000
c	10,000 new flood victims from 1999 rainy season	<u>2,000</u>
	Total	15,500 families

A significant number of these 15,500 families will be provided with an emergency solution of some kind or another through one of the other emergency housing programs being supported by the GOH and/or other donors. It is hard to say how many units will be made available through these other programs during the next six months, but we believe

¹ Note that a recent estimate by the Municipality of Tegucigalpa, cited above indicates 4,000 families (approx 20 000 people) at high risk in Tegucigalpa alone

an optimistic estimate would not exceed 5 500. If so, this leaves approximately 10 000 very low-income families without a permanent solution within this timeframe. At \$2 000 per serviced site (a conservative estimate), this means that the estimated unmet need could be met with a \$20 million program, if the proposed sites and services approach is adopted.

Component 4 Complementary Off-Site Services

The funding requirement for this component is based on the high probability that basic off-site utilities, mainly sanitary and water collector trucklines, plus electricity and road access to potential sites and service projects, yet undetermined or not selected at this time, may require significant resources. In the case of two sites examined by the USGS and USACE in Tegucigalpa (El Ingles and Las Trancas), the estimated off-site costs for both was approximately \$6 million. Given the number of municipalities requiring emergency sites and service lots (8-10), the range of funding for this component was determined between \$5-10 million.

Component 5 Technical Assistance and Cooperation

The level of funding for this component was determined on the basis of the respective planning figures of both USAID's Office of Regional Urban Development Programs (RUDO) and U.S. Department of Housing and Urban Development (HUD) proposed work in support of both initial reconstruction efforts and the mid-long term recovery needs of Honduras to achieve some degree of sustainability across an array of Honduran institutions in the sector and to contribute solidly to economic revitalization of the country. The RUDO budget estimate of direct bilateral support to USAID/Honduras mission's reconstruction program including direct participation (technical/managerial support) in the proposed program components # 1, 2, 3, and 4 over a 2-3 year period was calculated to be \$1.6 million.

In support of a range of regional Mith and George related activities important to the whole USAID Agency and to the LAC and Global Bureaus, it is proposed that a set of regional activities be considered that captures major synergies and efficiencies across countries, managed at the regional level, but designed and implemented in close consultation and coordination with the respective USAID missions and other national and municipal organizations operating in the region. Management of the proposed technical assistance activities related to housing finance and municipal strengthening is recommended to be coordinated at the regional level within USAID by G/ENV/UP and the RUDO/CA in collaboration with G/CAP in Guatemala and LAC/Washington. Where appropriate, these programs would be closely coordinated with HUD's Office of International Programs, and in many cases will be jointly planned and implemented in integrated teams along with USGS and USACE. Such activities would include donor coordination and information exchange, municipal disaster preparedness and mitigation planning, policy dialogue support to Missions in areas of housing and municipal infrastructure finance, including informal credit systems, etc. The estimated cost of these regional activities under G/ENV/UP and RUDO/CA leadership over a 3-5 year period is \$2 million.

**VII PROPOSED SUPPORT PROGRAMS OF
OTHER U S AGENCIES**

Outline of Future Activities in Support of the Hurricane Mitch Reconstruction Effort

**U S Army Corps of Engineers
3 February 1999**

- I Program & Project Management Program and project management is critical to the success of the restoration program. USACE is program management based, able to integrate the entire infrastructure restoration from "cradle to grave". USACE can pull planning, design and construction together to enhance efficiency and effectiveness and assure financial accountability of all resources expended.
- II Master Planning for Transportation, Utilities, and Other Infrastructure Road and rail systems as well as power, telecommunications, water, wastewater, and petroleum distribution systems are all inter-related. Sub-optimizing one area can negatively impact another. USACE can provide the broad based planning effort required to make the best use of all available resources. Also, replacing items "like in kind" may not be the best solution. There is an opportunity to improve the infrastructure in Central America to impact the long-term economic growth of the region.
- III Design and Construction Management USACE has decades of experience working with local architectural, engineering, construction, and supply firms in Latin America. The Corps can rapidly leverage these firms in order to jumpstart the reconstruction effort. USACE has Spanish-speaking engineers and project managers with sound knowledge of the local culture and engineering practices.
- IV Flood Plain Planning & Design of Control Systems The Corps' is the lead federal agency for flood prevention in the United States. USACE has vast knowledge of both structural and nonstructural alternatives in designing flood control systems. The Corps' could provide large-scale flood plain management for the region -- which in many cases would be interdepartmental and international in nature.
- V Environmental Protection and Restoration The economies of Central America are agricultural and tourism based with a developing manufacturing industry. As such, they are very vulnerable to environmental degradation. USACE is accustomed to working in close vicinity of our nation's major water systems and valuable environmental sanctuaries. The Corps' can help restore the infrastructure of Latin America while simultaneously protecting its valuable environmental resources and restoring those previously damaged.
- VI Damage & Technical Assessments A primary USACE competency is technical expertise in the full range of engineering disciplines. USACE can assess, quantify, and estimate the cost of damage to facilities, transportation, and utility systems (far more in depth than the Corps' Preliminary Damage Assessment Report of November 1998). The Corps' can also partner with local government ministries to share technical assistance and help develop host nation capabilities. The Corps' has already established working relationships with several host nation cabinet-level ministries.

USDA Wood Technology Exchange for Housing Reconstruction

Project Overview

To facilitate timely construction of durable, low-cost housing solutions for victims of Hurricane Mitch, USDA proposes the following technical exchange opportunities be considered. The near-term goal is to help solve the immediate need for low-cost permanent housing. Over the longer term, the goal is to help Honduras establish better practices for utilizing wood products in housing construction, including accessories and products which can be supplied from the United States or developed in joint venture with local industry. Creating an increased awareness and understanding of wood frame housing technology, as well as proper wood treatment and care will lead to micro enterprise development and new viable options for building solutions with a long lasting impact going far beyond the years of disaster response.

Targeted Area Areas where wood frame is a viable building solution, including areas suitable to post and beam structures, will be targeted. This includes the northern departments of Honduras (often subject to flooding), with 1/3 of the population and nearly 15,000 home losses from Mitch. Many in the region are familiar with wood frame homes built on post and beam by fruit companies in the 1940's. A program for the Tegucigalpa area may also be considered worthwhile.

Beneficiaries Constituents of NGOs, trade associations, local government entities, educational organizations, and U.S. companies involved in trade or investment with the region will benefit. Activities will be coordinated with other USG agencies (including HUD).

USDA proposes three main project activity components for a self-help housing assistance program.

Scope of Work

Self-help Housing technical assistance

Given funding availability, USDA will develop and implement a **Mutual Self-Help Housing Program** in Honduras. With a few modifications, the program will be similar to the USDA-Rural Housing Service program of the same title.

With oversight by USDA and through agreements with project supervisors, the program will provide technical assistance grants to local municipalities or non-profits to fund an apprentice development program for future home builders of wood frame construction. Apprentice builders will work with locals in a mutual self-help home construction effort aimed at conveying wood frame housing technology and building solid houses. In addition to a modest stipend, apprentices will come away from the program with the skills and ability to advance beyond the disaster response building period. The pool of possible apprentices will include students of industrial arts, tradesmen, laborers, and others as deemed suitable and appropriate.

Working under the supervision of U S technical experts, apprentices will gain the necessary skills for the construction of durable, low-cost housing solutions using proven wood frame housing construction techniques. In addition, their orientation will include exposure to environmental stewardship awareness and effective leadership principles. Most importantly, the apprentice builders will help hurricane victims not just build back, but build back better. Secondly, with the supervision and coordination experience gained with the damnificados and local NGOs/government entities building viable homes in the local market, the program will help establish apprentice credibility and generate business opportunities for viable micro-enterprise growth.

The goal is for each apprentice to oversee the self-help construction of 20 new homes during the project. U S experts will provide oversight for homes in the initial phase. The goal for the entire project is 500 new homes, i.e. 100 new homes for each U S supervisor.

Acquisition of land, basic services, and building materials will be provided through private arrangements, through NGOs, local government entities, and other USG programs. This will include a proposed USAID- funded program which intends to obligate grants to damnificado for housing reconstruction. The small grants (est. \$1,000-\$2,000 per family) can be used to fund land, water and sanitation services, and a building materials package.

USDA Role- USDA will set up the activities, make arrangements with facilitators, oversee the activities and provide information resources including expert industry representatives, handout information such as step-by-step videos, guidebooks, and industry documentation. USDA will also create a short (15-20 minute) project documentary video to capture the progress achieved with the activities.

Role of U S experts-

- work closely with USDA on program operations and requirements for success
- communicate requirements to program participants, NGOs and government entities
 - * establish clarity of NGO and govnt roles, especially re land and service needs
 - * clarify program and self-help labor requirements
 - * help NGO entities identify candidates for program
- effectively communicate apprentice roles and responsibilities
- work effectively with pool of program apprentices
- provide professional classroom instruction including
 - * site identification, preparation, and development
 - * overview of options for building design, layout, and material selection
- demonstrate, assist, and supervise on-site home construction and completion including
 - * foundation, floor, wall, and roof framing for plumbness and durability
 - * minimizing future damage (wind load, moisture, termites, fire)

Project Schedule

Part I Working in coordination with the Foreign Agricultural Service field office and local NGOs and government entities, the project will be initiated with a program opportunity overview and a short (7-14 hour) construction technology seminar which will introduce the option of wood frame technology. More than one seminar location may be needed depending on the needs of participants.

Part II Local entities which indicate interest in the program will be considered for participation in Part II. A pre-visit by USDA to the local entities will determine their abilities to succeed in the program. This will include an examination of organizational ability and local resources including, land, services, labor, beneficiaries, and funding availability. Entities which meet the program requirements will be selected to participate. Further details of upcoming technical exchange activities including apprentice recruitment, training schedule, and grantee consignment issues will be set up with each organization participant (OP). Participating organizations will be responsible for recruiting apprentice candidates as well as future home owner/builders for the mutual self-help home construction program. OP groups will also help the building teams secure materials from local sources, including use of staff, phones, vehicles, etc. as needed. OP groups will receive the necessary project fees to offset their expenses.

U.S. technical experts will begin with a three-week training and construction mission to initiate proper home construction techniques with each of the apprentices. Day to day activities during the mission will include both classroom and on-site construction demonstration. The technical experts will each conduct follow-up missions with their apprentice groups to monitor progress and provide additional instruction, solve unique problems, etc.

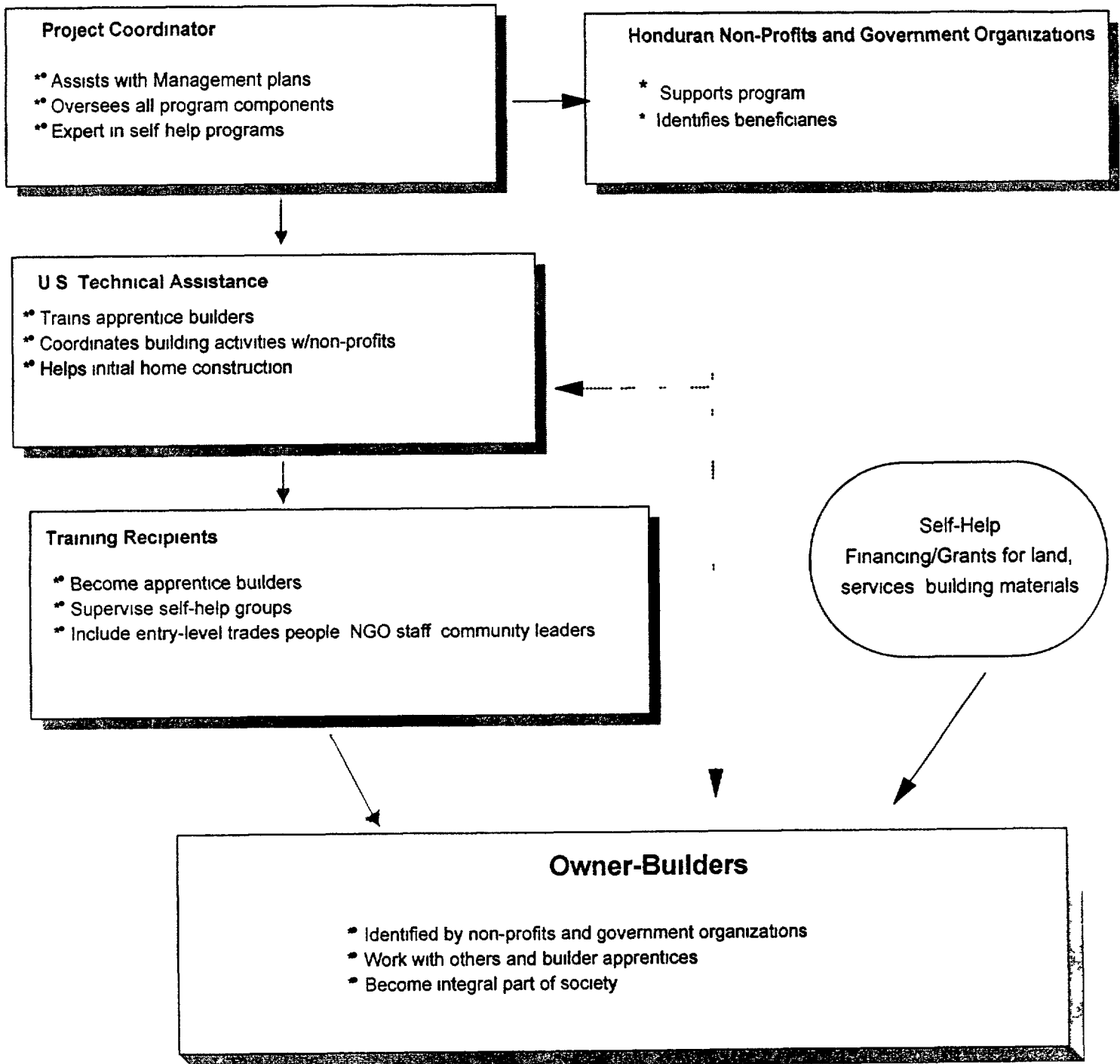
Part III As the build-out goals of each of the OP groups and apprentice builders are completed (or nearly completed), a leadership/business development conference mission will be conducted. The aim of the mission will be to bring together all the active program participants and recognize project accomplishments, strengthen local institutions, identify future viable business options, and encourage U.S. partnering. In addition to attendance by all the active local participants (including OPs, apprentices, suppliers, project affiliates, etc.), USDA will recruit potential business partners from related U.S. industry to attend the conference. The program will be facilitated by a well recognized leadership training expert.

Project Funding

The estimated activity funding requirement is \$350,000.

USDA Mutual Self-Help Housing Project for Honduras

DRAFT



Beneficiaries



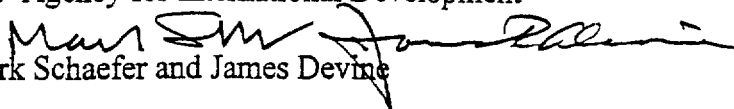
United States Department of the Interior

OFFICE OF THE SECRETARY
Washington, D C 20240



February 8, 1999

Memorandum for Mark Schneider and Donald Boyd
U S Agency for International Development

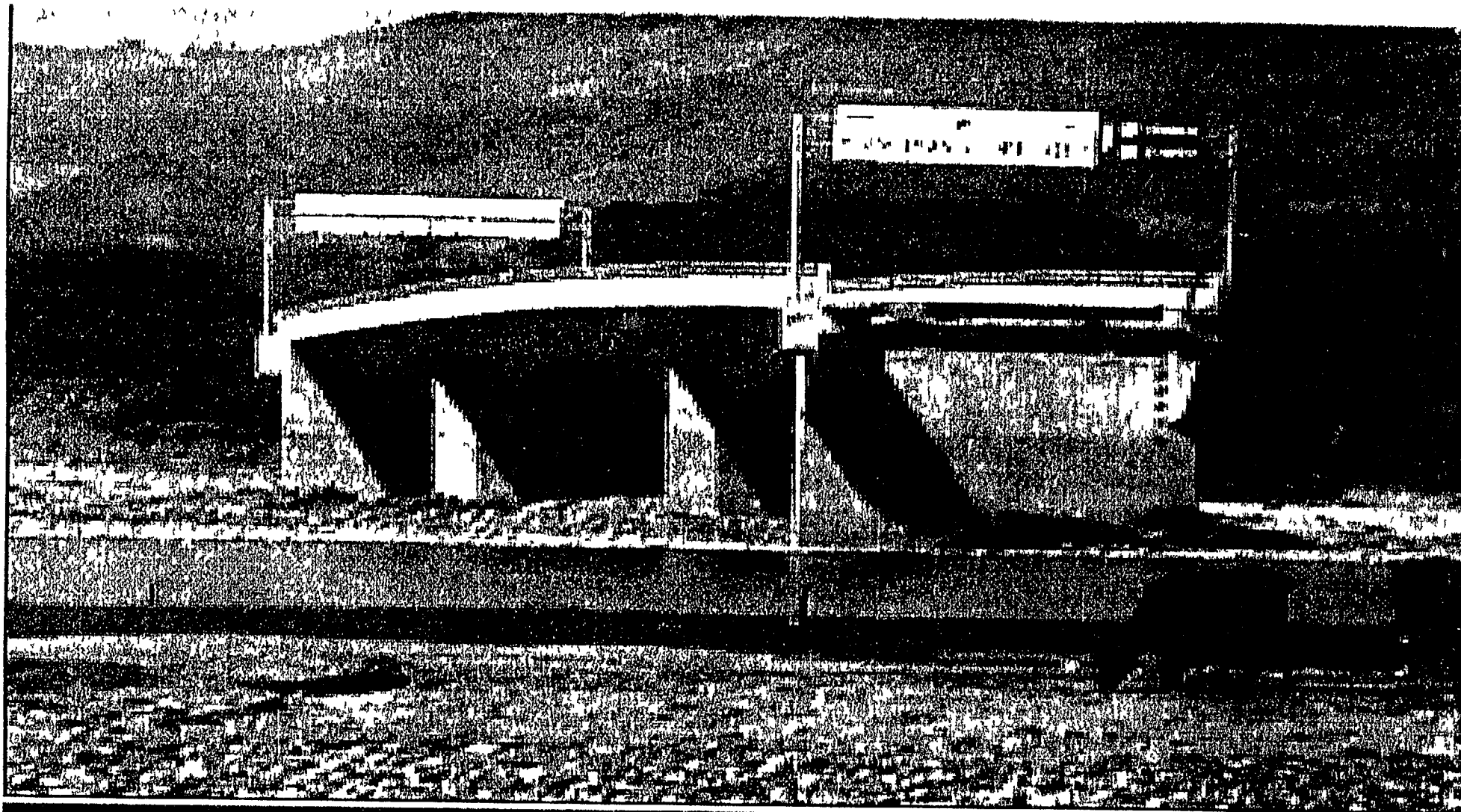
From  Mark Schaefer and James Devine

Subject Near-Term Support for U S Geological Survey Activities in Response
to Hurricane Mitch

Attached as you requested is a proposal for funding to support U S Geological Survey (USGS) activities related to Hurricane Mitch for the next several months. As you know, the Department of the Interior and USGS have been working since the Hurricane Mitch disaster to support U S AID activities in Central America. These funds would allow USGS to continue to provide technical assistance and a wide range of mapping and information products until emergency supplemental funds are hopefully secured.

We appreciate your assistance and look forward to continuing this very successful partnership.

attachment




Integrated Damage-Risk Assessment and Mitigation

Proposed U.S. Geological Survey Activities in Support of
the Hurricane Mitch Reconstruction Effort

February 8, 1999

I – Providing basic information tools

BEST AVAILABLE COPY




Center for Integration of Natural Disaster Information

USGS Works With Partners to Meet Challenge of Providing Disaster Information

The U.S. Geological Survey's Center for Integration of Natural Disaster Information (CINDI) is a research facility for (1) developing and evaluating technology for disaster mitigation and disaster relief; (2) providing research data and information.

Current Event



USGS

Center for Integration of Natural Disaster Information

Disaster in Central America

USGS Science Team in Honduras

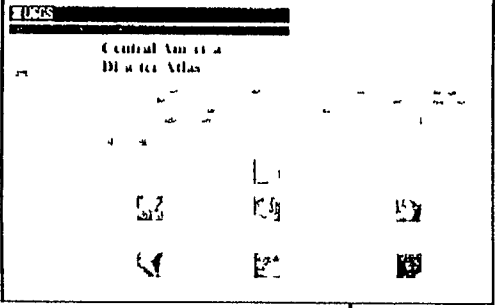
[Click here for disaster information](#)

DOI Earthquake Science Highlighting Honduras Region from Hurricane Mitch

Central America Interactive Atlas

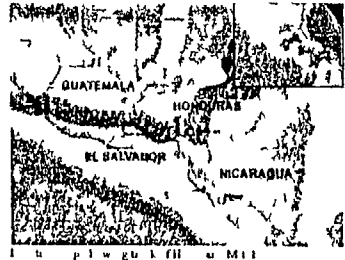
[Click here to visit your window of Central America](#) and download data

Central America Disaster Atlas



Central America Interactive Atlas

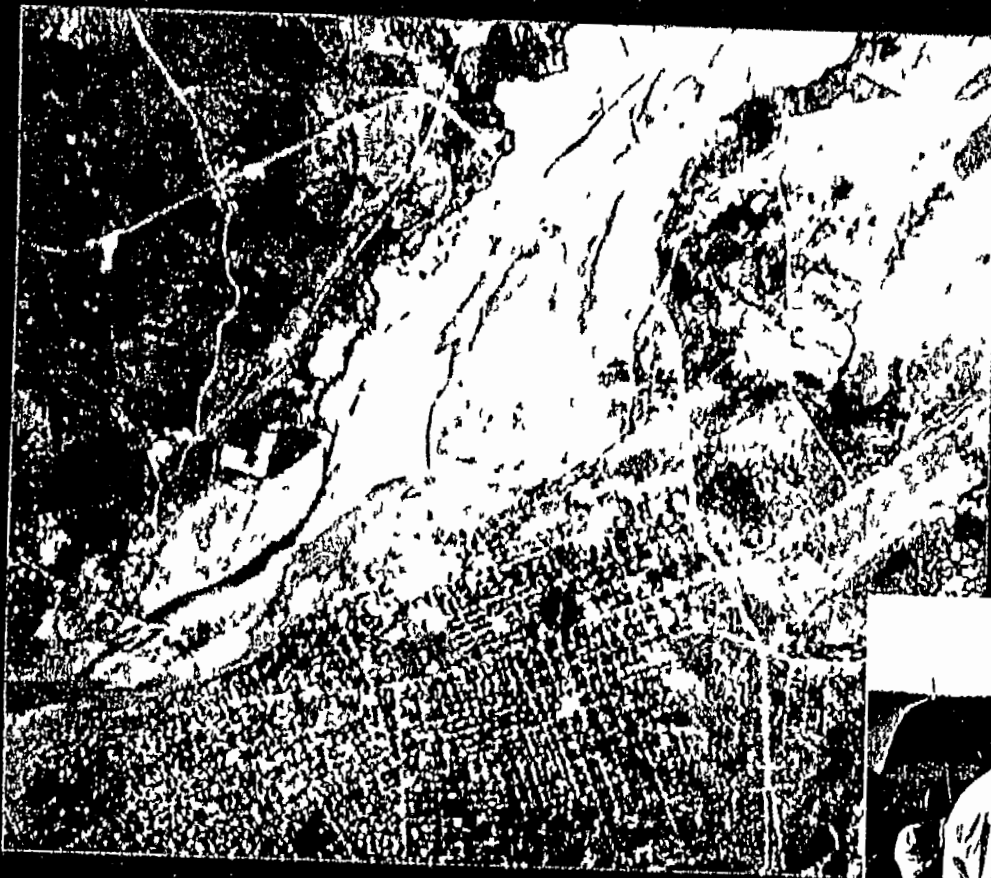
[Click here to visit your window of Central America](#) and download data



USGS will continue its present role as a data gatherer, archiver, and integrator for the reconstruction effort. This will include providing and/or facilitating access to existing digital maps, aerial photography, satellite imagery and other data, and developing integrated databases from these sources.



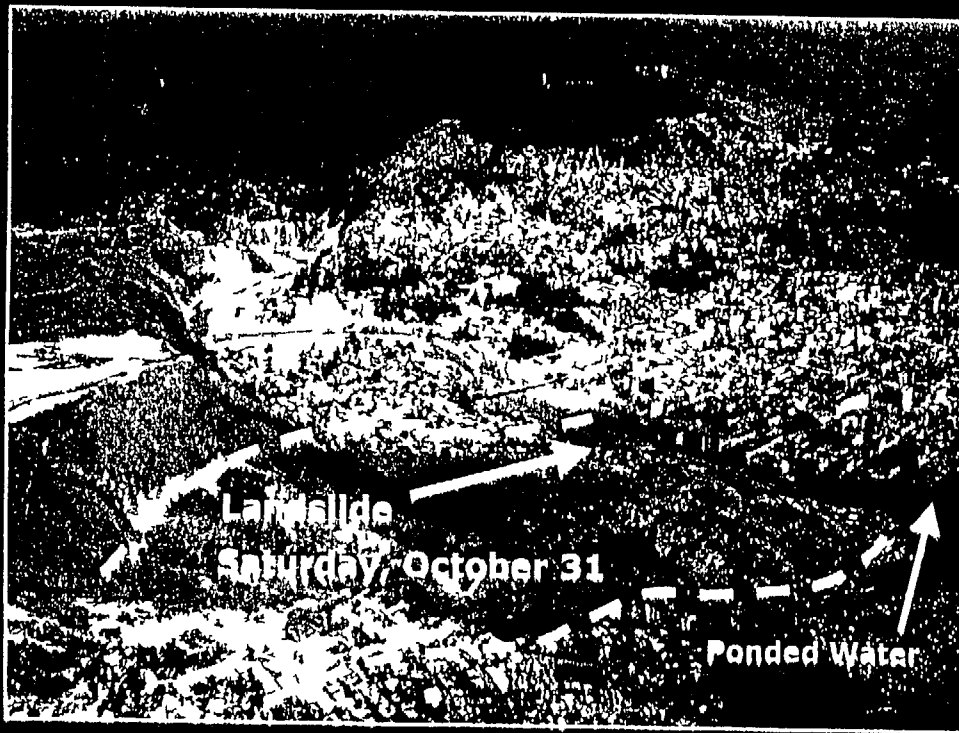
II – Acquisition of New Data



Assist in the acquisition of new aerial photography and satellite imagery; gather new hydrologic, geologic, and biologic field data for use in damage and risk assessments

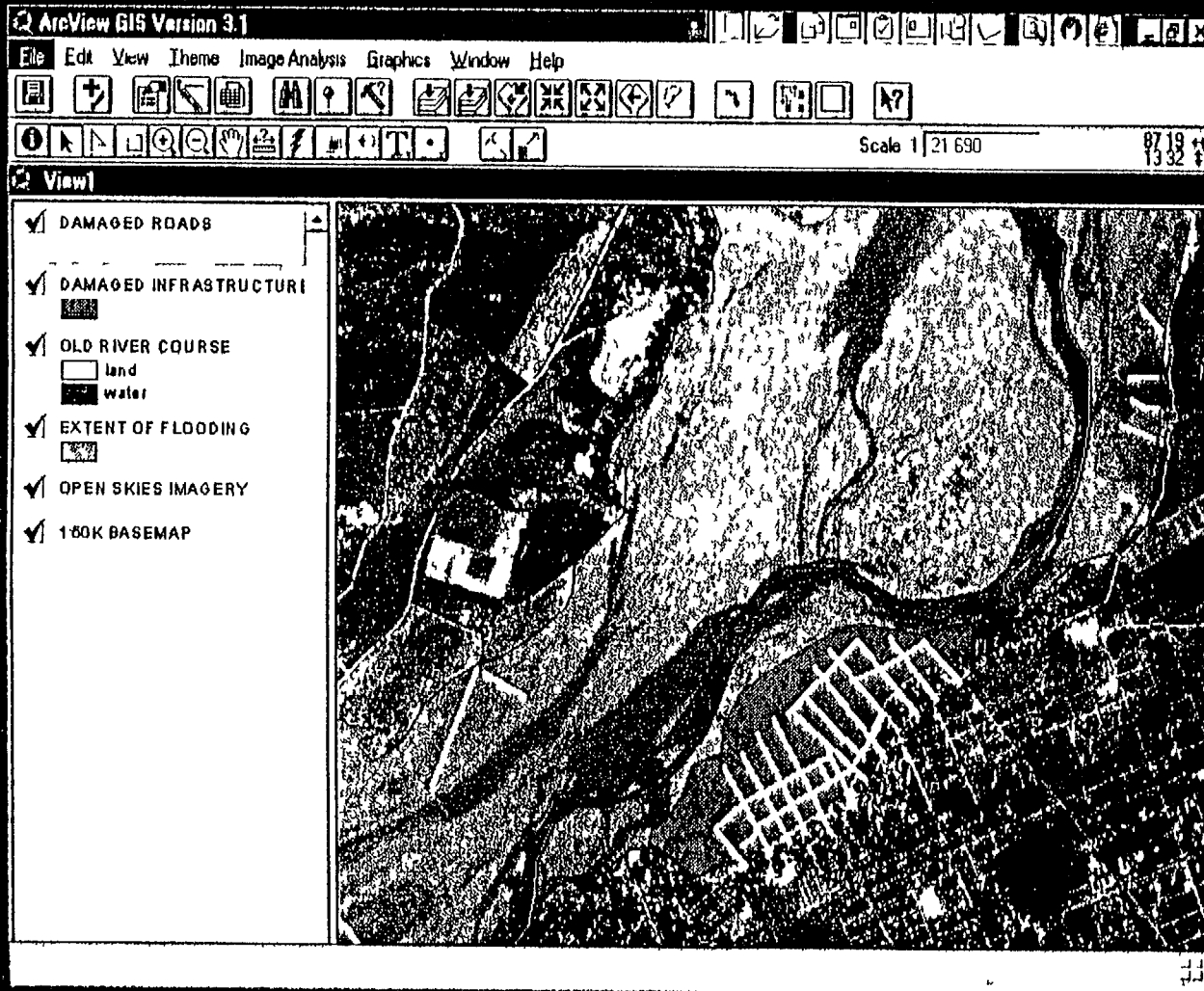


III – *Damage/Risk Assessment & Mitigation*



Further characterize the impact of Mitch-related flooding and landslides in priority areas; assess and monitor the potential threats from future events to population, infrastructure, water supply, and agriculture.

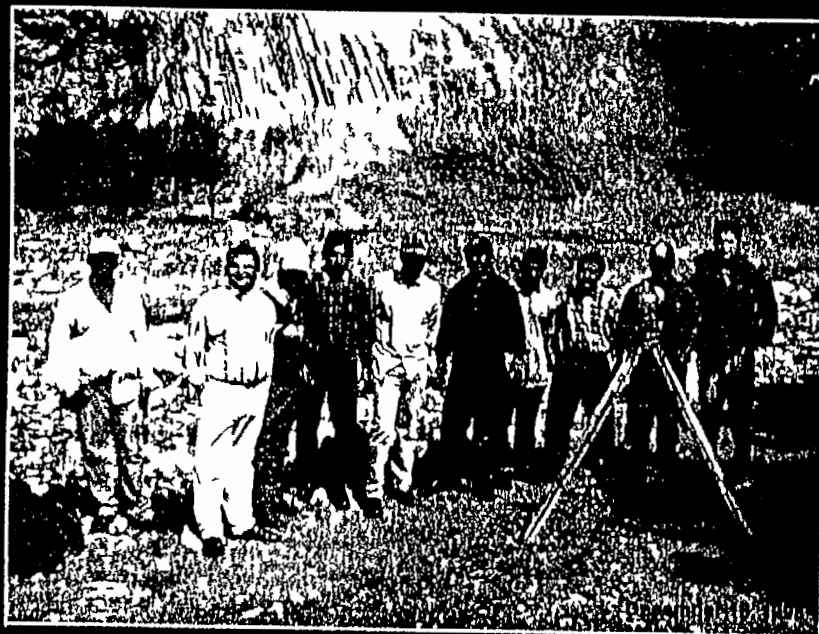
IV – Development & Delivery of Integrated Data Products



Integrate the results of damage and risk assessments with base maps, aerial photography, and satellite imagery in a GIS format; deliver these data sets as working tools to guide decision-making in the reconstruction effort

BEST AVAILABLE COPY

V – Capacity Building



All USGS activities will be conducted in close cooperation with counterpart agencies in Central America. Additional training and equipment/software will be provided to strengthen existing capacities and build new in-country capabilities to maintain these programs in the future.











U S. Geological Survey - Integrated Damage-Risk Assessment and Mitigation

Category	Tasks Requiring Immediate Action	Through 4/99	5/99 – 12/99	through 2001
I	Compile 1:50,000 scale digital map coverages for major river drainage basins Choluteca, Ulua, Nacaome, Congrejal)	→		
I	Digitize aerial photography for principal urban areas with the above basins Tegucigalpa, Choluteca, San Pedro Sula, Choloma, El Progreso, La Lima, La Ceiba, Pespire, Olanchita	→		
II-III	Prepare landslide inventory/risk map for Tegucigalpa	→		
IV	Prepare pilot GIS of Choluteca to demonstrate integration of base maps, aerial Photography, damage and risk assessment data, and other information for decision support	→		
II-III	Prepare flood hazard maps for each drainage basin (coarse-scale) and for urban areas (fine-scale) in Honduras	→		
III	Prepare landslide inventory/risk maps for major drainage basins and principal urban areas in Honduras	→	→	
III	Install two flood-warning stream-gage stations on the Rio Choluteca above Tegucigalpa and Choluteca	→		
II-III-IV	<p><i>Send team USGS team to Honduras to</i></p> <ul style="list-style-type: none"> Establish control points to monitor movement in landslide-prone areas of Tegucigalpa Make slope & area measurements on Choluteca and Ulua Rivers for peak-discharge calculations Establish sampling program for water-quality sampling on Choluteca River between Tegucigalpa and Gulf of Fonseca Establish additional data center in San Pedro Sula for Sula Valley 	→		

Funds Required to Continue Operations Through April, 1999

\$600,000

U.S. Geological Survey - Integrated Damage-Risk Assessment and Mitigation

Category	Tasks Requiring Eventual Action	5/99 – 12/99	through 2001
III	Install additional flood-warning gage stations in selected drainage basins in Honduras and Nicaragua		
I-V	Establish web-servers and internet data distribution nodes in Tegucigalpa and Managua Sites will be part of InterAmerican Geographic Data Network (IGDN)		
I-V	Establish small map and data distribution centers in principal urban areas of Honduras and Nicaragua, to be tied to main centers in Tegucigalpa and Managua		
I	Digitize and make available all aerial photography from December 1998 Open Skies missions for Honduras, Nicaragua, and El Salvador		
I	Digitize and make available additional aerial photography needed to provide full coverage for Honduras and priority areas in Nicaragua and El Salvador		
I	Acquire and process post-Mitch Landsat TM Satellite imagery		
II-III	Assess volcanic-eruption and debris-flow risk for coastal Nicaragua and El Salvador		
IV	For principal urban areas, complete integrated GIS's, containing base maps, aerial photography, damage assessments, flood and landslide risk assessments, field reports, video and still images of damaged infrastructure and proposed relocation sites		
II,III,IV	Survey and assess damage and risk to principal agricultural areas and timber resources This component will be coordinated with Department of Agriculture and U S Forest Service		
II,III,IV	Survey and assess damage to coastal areas, with attention to impact on aquaculture and tourist areas		

**Tentative Areas of Focus for the
U S Department of Housing and Urban Development (HUD)**

I Empowering and Building the Capacity of Municipalities

- Ensuring successful "in-filling" in urban areas

If a critical component of reconstruction is the placement of the displaced in urbanized lots, there are a number of strategies municipalities can use to improve the potential for successful integration of mixed populations in urban neighborhoods. HUD would focus on discussing and exploring strategies for municipalities to use in successfully re-integrate the displaced population.

- Managing urban growth and "sprawl"

Urban growth is creating new issues for municipalities. The rate of urban migration will likely increase as a result of Hurricane Mitch, particularly as agriculturalists search for jobs. HUD would promote the exchange of information on strategies and approaches to community planning and managing urban growth (particularly by bringing together U.S. and Honduran municipal officials), this could be integrated into the existing urban planning efforts supported by the mission. Emphasis will be placed on approaches involving high levels of community involvement and participation in development and planning.

- Collecting and using data and statistics for urban planning and management

Data and statistics will be critical tools for managing the allocation of resources to various classes of victims. Such information will also be critical to managing urban development and fostering the creation of new financing mechanisms for the housing sector. HUD has extensive expertise in the collection, analysis and use of data and information on income, housing stock, ownership, income and the composition of urban populations. Assisting with the enhancement of such capacity locally would have enormous benefits related to reconstruction as well as long-term urban development benefits.

- Clarifying the Municipal Role in Disaster Management

Balancing authority and responsibility between local and national government when there is a natural disaster is challenging. There is ample scope for discussing alternative approaches to collaboration. HUD would focus solely on catalyzing the interest of U.S. municipalities in working with Honduran municipalities (and central government authorities) to explore how different levels of government collaborate and divide-up responsibilities when there is a disaster. HUD's efforts would particularly emphasize involvement of cities that have faced disaster in collaboration with federal officials (e.g. FEMA, the National Guard).

II Improving the Availability of Financing

- Fostering Mainstream Lender Entry into the Market for Low Income Borrowers

Critical to the large scale availability of financing for low and medium income families is the involvement of mainstream lenders HUD would bring together mortgage bankers and other mainstream U S banks to work with Honduran banks in developing strategies for lending to poorer client groups, and to examine strategies that have been used in the U S to foster lending in poor neighborhoods Included in this exchange would be discussions exploring different strategies and products which mainstream U S banks use to lend to municipalities

- Sharing Models for Community Banking

HUD would focus on examining (and helping adapt) models for community and cooperative banking that have been used in poor urban areas The focus would be on working with NGOs and other local community groups to develop self-help banking strategies

III Enhancing Building and Construction – Technology Cooperation

- Assisting NGOs, universities, and the private sector to enhance the design of new housing

As designs for new housing are developed, small *low and no cost* design modifications could improve the safety and durability of the buildings In the immediate term, HUD and its partners would provide a forum for technical exchange to the groups designing housing for displaced persons Building on this foundation, HUD would help further promulgate and disseminate best practices by working with NGOs, universities, and key opinion leaders in the housing and construction industry to help foster the exchange of information and technology cooperation to improve building techniques and technologies

- Assisting with the development of locally-appropriate market-driven codes and standards

In the *long-term*, building codes and standards will enable standardization and ensure improved safety HUD would work with partners such as the National Conference of State on Building Codes and Standards to promote the development of building codes and standards

IV Involving the Private Sector to Promote Economic Revitalization and Technology Cooperation

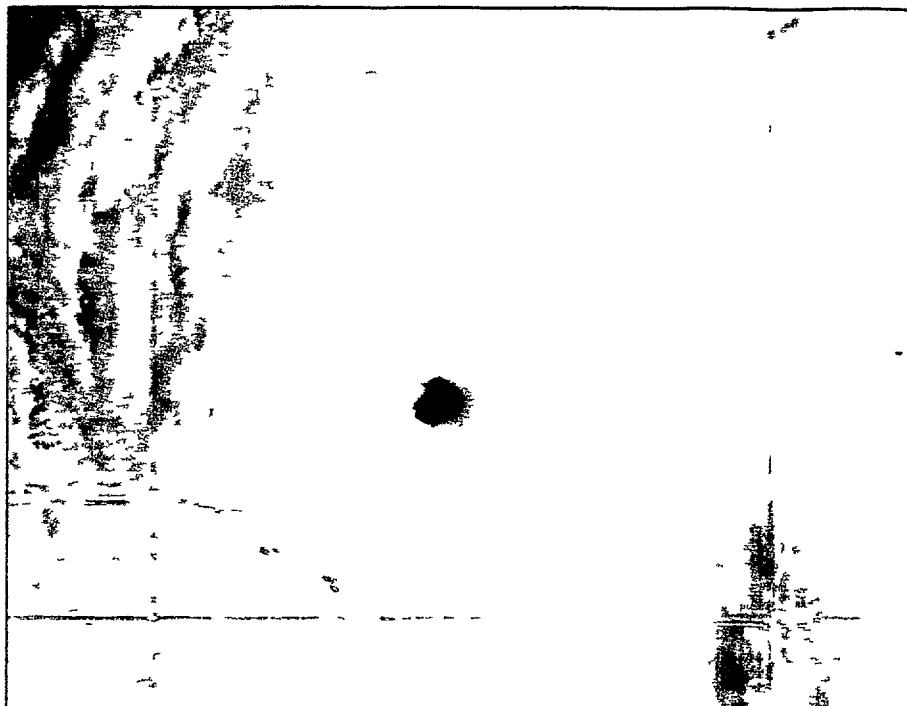
- Promoting joint ventures in housing and construction industry

There is enormous interest in U S industry in helping support reconstruction and promote investment and trade with Central America, this would foster economic revitalization by providing foreign exchange and employment HUD would focus on helping to stimulate joint ventures in housing and construction that would promote local production while supplying needed goods and materials locally and to the US In partnership with organizations such as FIDE, COHEP, the National Association of Home Builders and the Manufactured Housing Association, HUD would focus on bringing together potential Central American and US partners

- Designing and procuring basic housing solutions for displaced families

In the immediate term, moving refugees from "macro albergues" to permanent, safe, new homes will be critical to staving-off migration and successfully reintegrating displaced members of the population HUD offers the greatest access to technological know-how technology and US private sector entities interested in assisting reconstruction through donations and at cost contributions of skill labor and material HUD would design and procure basic housing for distribution/sale to new land holders [The materials could be procured locally, when appropriate The design would be developed and tested locally It is HUD's hope that its procurement of basic materials "kits" could flow into a distribution and financing mechanism jointly developed with USAID and others and implemented by USAID and its local partners]

Evaluation of Housing and Infrastructure Reconstruction following Hurricane Mitch, Honduras



February 1999

Prepared by

United States Army Corps of Engineers United States Geological Survey

University of South Carolina

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Evaluation of Housing and Infrastructure Reconstruction Following Hurricane Mitch, Honduras

Executive Summary

February 1999

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United States Army Corps of Engineers United States Geological Survey

University of South Carolina

During the period 25-31 October 1998, heavy amounts of rainfall occurred as Hurricane Mitch meandered across Honduras. Rainfall amounts ranged from 565.5 millimeters (mm) (22.3 inches) to 2541 mm (10 inches) in the capital city of Tegucigalpa in central Honduras to 893 mm (35 inches) in the southern part of the country. As a result of this intense rainfall, significant flooding and streambank erosion occurred throughout the country. Additionally, the intense rainfall triggered numerous landslides, which contributed large amounts of sediment into the river systems leading to significant accumulation in the riverbeds and in the floodplain.

In the aftermath of Hurricane Mitch, the focus with respect to shelter was on providing temporary shelters for displaced persons. However, in the intervening months, many municipalities have moved forward toward permanent solutions. By invitation of USAID (Washington D.C. and Honduras) personnel, the U.S. Geological Survey and U.S. Army Corps of Engineers (and a representative of the University of South Carolina) were asked to provide an evaluation of those urban areas where a large number of housing losses occurred. The team was asked to evaluate any proposed housing relocation sites with respect to flooding and landslide hazards, and adequacy of water supply, sanitation, and site access. Additionally, the team was asked to evaluate proposed plans for infrastructure reconstruction, and to make recommendations regarding the suitability and feasibility of the plans. This report documents the findings and recommendations of this interagency team. The designated municipalities in Honduras are

- ◆ Tegucigalpa
- ◆ Choluteca
- ◆ Pespire
- Choloma
- ◆ La Lima
- ◆ El Progreso
- ◆ La Ceiba

Within the departments where these communities are located, the Government of Honduras estimated that 15,400 homes were destroyed and 23,300 were damaged, accounting for almost 50 percent of the totals for Honduras.

In general most of the proposed relocation sites were located outside existing floodplains and landslide terrain and, with a few exceptions were not in areas where future flooding and landslide hazards will be significant. Some of the sites located at higher elevations will have problems with obtaining viable sources of water. For those sites water will need to be trucked in to the site, the existing municipal system will need to be extended to serve the new community, or a new surface water source will need to be developed. Also, sanitation issues were likely to be problematic in that establishing simple latrines may not be acceptable. A primary sewage treatment system such as an oxidation pond should, at a minimum, be used. With regard to the El Ingles site in the Tegucigalpa area, site access via the existing road is difficult and subject to hazards from landslides.

Portions of the seven communities continue to have a flooding risk and Tegucigalpa has areas of high landslide potential. For these communities, the interagency team recommended a variety of mitigation measures, some requiring construction or repair/rehabilitation of projects (structural measures) and some requiring collection, analysis, and presentation of data, capacity building (training), or governmental actions that can be taken to limit future flood damages and loss of life (non-structural). Some of these recommendations can and should be taken before the onset of the next rainy season (May 1999). Others will require considerable investigation and analysis to identify the most feasible or practicable solution. The team's recommendations are summarized below.

Tegucigalpa

Short Term

- Prohibit reconstruction of homes on El Berrinche and El Reparto landslides
- Regrade landslide surface and seal open cracks
- Survey landslides and monitor for renewed movement
- Prohibit reconstruction of homes within 100 meters of the Rio Choluteca
- Continue excavating sediment from the Rio Choluteca channel
- Conduct hydraulic analyses (indirect discharge measurement) of Rio Choluteca and major tributaries to determine peak discharge

Intermediate Term

- Develop a landslide inventory, GIS analysis, estimate sediment production by landslides
- Remove structures severely damaged by flooding that encroach on the Rio Choluteca channel
- Install realtime streamflow gaging station and precipitation gage network
- Conduct "indirect" peak discharge surveys and computations for selected reaches of the Rio Choluteca and its major tributaries
- Conduct hydraulic analyses to define floodplain limits and determine required capacity of hydraulic structures

Long Term

- Design and construct landslide stabilization measures
- Conduct comprehensive analysis of water resources and recommend projects for construction

Choluteca

Short Term

- Prohibit construction of homes destroyed by flooding
- Construct a realtime streamflow gaging station upstream of Choluteca
- Conduct hydraulic analyses ("indirect" discharge measurements) of Rio Choluteca and major tributaries to determine peak discharge

Intermediate Term

- Rebuild damaged bridges with additional flow relief openings
- Conduct landslide inventory, GIS analysis, estimate sediment production by landslides

Long Term

- Conduct comprehensive analysis of water resources and recommend projects for construction

Pespire

Short Term

- Install permanent markers showing limit and height of Hurricane Mitch flooding
- Prohibit reconstruction of homes in area where homes were destroyed
- Allow repair of damaged homes on the floodplain fringe
- Construct a realtime streamflow gaging station upstream of Pespire on the Rio Nacaome
- Conduct hydraulic analyses ("indirect" peak discharge measurements) of Rio Nacaome

Intermediate Term

- Conduct analysis to define floodplain limits
- Develop GIS for the Rio Nacaome in the vicinity of the town of Pespire

Choloma

Short Term

- Repair breached levee sections with increased height in vicinity of adjacent communities

Intermediate Term

- Require first floors of new construction to be elevated 1 to 2 meters above the floodplain
- Develop GIS for the Sula Valley

Long Term

- Conduct comprehensive analysis of water resources and recommend projects for construction for the Sula Valley

El Progreso

Short Term

- Dredge/excavate Rio Pelo channel
- Prohibit reconstruction of destroyed homes
- Construct a realtime streamflow gaging station upstream of El Progreso on the Rio Pelo
- Conduct hydraulic analyses ("indirect" peak discharge measurements) of Rio Pelo

Intermediate Term

- Construct a structure to divert sheetflow (north El Progreso) into established channels
- Conduct analysis to define floodplain limits
- Evacuate structures in active floodplain of the Rio Pelo
- Install channel bank protection
- Develop GIS for the town of El Progreso

Long Term

- Evaluate potential for landslides in Rio Pelo headwaters Design and construct needed mitigation measures

La Lima

Short Term

- Prohibit reconstruction of destroyed homes

Intermediate Term

- Require first floors of new construction to be elevated 1 to 2 meters above the floodplain--Develop GIS for the town of La Lima

Long Term

- Conduct comprehensive analysis of water resources and recommend projects for construction for the Sula Valley

La Ceiba

Short Term

- Provide bank protection measures to eroded areas
- Conduct an indirect measurement of peak flow on the Rio Cangrejal
- Install a realtime streamflow gaging station upstream of the town of La Ceiba
- Develop detailed GIS for the Rio Cangrejal in the vicinity of La Ceiba

Intermediate Term

- Begin debris removal to protect bridges for damage from debris accumulation and the adjacent areas from higher flood stages associated with the obstructed flow

Long Term

- Data collection and analysis to determine future flood conditions to be used to set minimum house floor elevations and floodplain areas
- Investigate ways to increase capacity of water supply reservoir for Por Venoir

General/ Countrywide

- Capacity building
- Hydrologic modeling
- Hydraulic modeling
- Natural disaster response planning
- Stream gage network and simulation ("indirect" peak discharge measurements before rainy season)
- Stability analysis and instrumentation
- Hazard assessment
- Sediment budget including
- Landslide contribution
- Landslide hazard assessment

Evaluation of Housing and Infrastructure Reconstruction Following Hurricane Mitch, Honduras

February 1999

Prepared by

United States Army Corps of Engineers

United States Geological Survey

University of South Carolina

Introduction

In the aftermath of Hurricane Mitch, the focus with respect to shelter was on providing temporary shelters for displaced persons. However, in the intervening months, many municipalities have moved forward toward permanent solutions. The purpose of this report is to provide an evaluation of those urban areas where a large number of housing losses occurred, and to evaluate any proposed housing relocation sites with respect to hazards associated with flooding and landslides, and adequacy of water supply, sanitation, and site access. Additionally, the team was asked to evaluate proposed plans for infrastructure reconstruction, and to make recommendations regarding the suitability and feasibility of the plans. These municipalities are

- ◆ Tegucigalpa
- ◆ Choluteca
- ◆ Pespire
- ◆ Choloma
- ◆ La Lima
- ◆ El Progreso
- ◆ La Ceiba

Specific issues evaluated include landslide and flooding potential, water supply, wastewater treatment, mitigation measures, site access, and environmental and socio-economic concerns.

Tegucigalpa

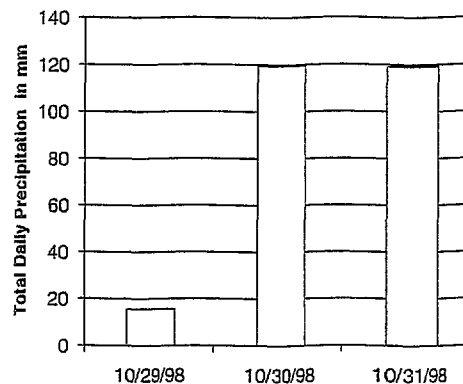


General

The capital city of Honduras, Tegucigalpa, lies within the Francisco Morazan Department. The City of Tegucigalpa, with a 1997-population estimate of 784,393, is home to approximately 75 percent of the departmental population. The Francisco Morazan Department is Honduras' most populated, composing about 18 percent of the Country's population. The population of the Department in 1997 was 1,041,570.

Description of Problem

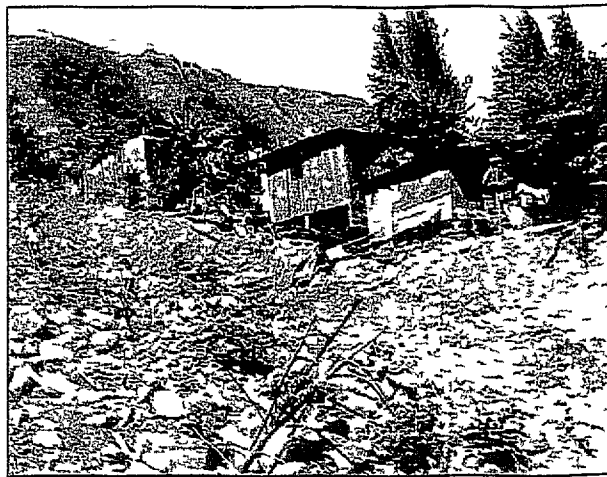
During the period 25-31 October 1998, 254.1 millimeters (mm, 10 inches) of rainfall fell in the Tegucigalpa area. The heavy rainfall caused extensive flooding in Tegucigalpa and Comayaguela. Additionally, the heavy rainfall triggered numerous landslides, including the extremely destructive El Berrinche landslide, which destroyed hundreds of homes in the Colonia Soto (approximately 5 to 7 million cubic meters of material were displaced).



In addition to the flooding, extensive sediment deposition occurred, including incursion of the El Berrinche landslide into the Rio Grande Choluteca. The extreme amount of sedimentation has reduced channel capacities in the Rio Grande Choluteca and its tributary channels throughout the urbanized areas of Tegucigalpa. It is estimated that 4,400 houses were destroyed within the Francisco Marazon Department.

Landslides

El Berrinche Portions of two colonias, Soto and 14 de Febrero, sit at the head scarp of the El Berrinche landslide on the upper right and upper left sides (looking upslope), respectively. Tension cracks from the head-scarp area of the landslide extend into each of these colonias near houses that are sitting adjacent to the head scarp. In the next rainy season, additional slumping from the head scarp area is likely to take place and result in the displacement of the areas where houses sit next to these cracks. Continued movement may take place for several years in which portions next to the head scarp area of the landslide may slump onto the present landslide mass in a retrogressive (progressing upslope) manner. Residences adjacent to the head scarp of the El Berrinche landslide should be evacuated and the occupants relocated especially if tension cracks now extend within the houses or within several meters of individual houses. If not evacuated, these areas of houses need to have survey markers established near them and monitored at regular intervals so that any renewed movement can be detected and the people warned of imminent movement and slope failure.



Homes perched dangerously close to the El Berrinche slide

Colonia El Reparto Several houses within Colonia El Reparto are located near the upper left side (looking upslope) of the head scarp of the El Reparto landslide. Similar to the situation in those colonias near the El Berrinche landslide, the homes in Colonia El Reparto are located within 10 meters of the landslide head scarp. No cracks are presently evident extending immediately adjacent to the houses, and the residences may escape involvement in renewed slumping from the head-scarp region of the landslide in the next rainy season (May – November 1999). However, survey markers need to be placed above the head-scarp area near these houses so that any recurring movement can be detected and the people warned. People should be evacuated at the first sign of renewed movement. Renewed movement of the slide would indicate that the houses are becoming

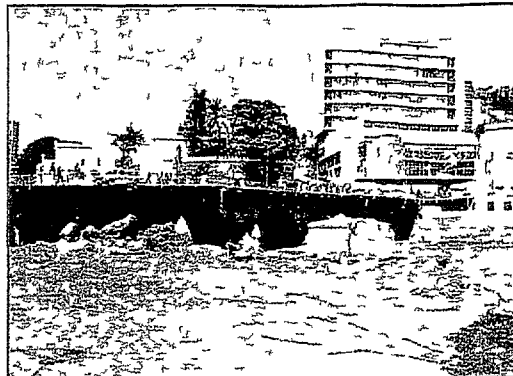


El Reparto landslide that destroyed numerous homes

part of retrogressive slumping that is likely to take place in the head-scarp of the landslide for several years

Flooding

The major rivers in the Tegucigalpa area peaked in the late night and early morning hours of 30-31 October 1998. In addition to extensive flooding, the high peak flows caused significant scour and erosion of the streambanks resulting in the destruction of numerous homes as well as the destruction of several bridges. Along the Rio Choluteca and Rio Chiquito in Tegucigalpa, floodwaters engulfed dwellings located more than 3 city blocks from the rivers, where substantial damage to homes and businesses occurred, as well as deposition of mud and debris several meters deep when floodwaters subsided. The downstream toe of El



Extensive sediment deposition has greatly reduced the bridge capacities in Tegucigalpa



Heavy sediment deposition characterized the flooding in Tegucigalpa

Berrinche landslide dammed the Choluteca River resulting in substantial aggradation of sediment in the river channel for approximately 1 to 2 km upstream of the slide. Due to the tremendous amount of sediment which has been introduced into the entire river drainage system, higher (river stage) than normal rainy season flows/floods can be expected over the next few seasons. Sediment deposition will re-occur in the dredged rivers resulting in additional channel maintenance costs in the future as the channel re-adjusts to the increased sediment availability caused by Hurricane Mitch.

Mitigation Measures

- *(Short Term)* The city of Tegucigalpa should prohibit residents from rebuilding homes on the El Berrinche and El Reparto slides
(City of Tegucigalpa)
- *(Short Term)* Inexpensive measures such as surveying and monitoring control points for any renewed movement within the head-scarp area of Colonia El Reparto are recommended
\$5 000 - \$15 000
(Corps of Engineers)
- *(Short Term)* Other inexpensive measures also can be undertaken to decrease the risk of renewed landslide movement. Water continues to seep into the head-scarp area and seep from springs forming a pond on the upper reaches of the landslide. Diverting the surface flow of water from the landslide mass would help to prevent saturation of the slide mass. Also water

emanating from the landslide mass should also be channeled off of the mass to remove as much water from the landslide as possible. Lined surface channels to divert and drain surface waters should be constructed to remove water from the landslide and prevent it from saturating other adjacent slopes. Sealing open cracks of the landslide surface would also help to prevent rainwater from infiltrating the slide mass. Expenditures to accomplish the surface drainage, the sealing of fractures, and monitoring of future movement within adjacent colonias would range from \$10,000 to \$50,000. Recommendations that relate to diverting surface waters from the landslide have been described in a previous report by the U.S. Army Corps of Engineers to USAID.

\$10,000 to \$50,000

(Corps of Engineers)

- *(Short to Long Term)* To fully mitigate the present and future landslide hazards that may occur from the El Berrinche landslide, a complete geotechnical sampling, testing, instrument installation, stability analysis, and mitigation program would need to be undertaken. The sampling, testing, and instrument monitoring of the landslide and its materials would allow the calculation of the present factor of safety and the conditions with respect to groundwater levels under which the landslide would begin to show additional movement. Such a stability analysis may suggest the specific mitigation measures to be undertaken. Mitigation and construction efforts to prevent future landslide movement would depend on the results of the analysis, however, such measures as the installation of retaining structures and surface and subsurface drainage would likely be around \$1.5- to \$2.0-million.

\$500,000 to \$750,000 Data Collection and Analysis (Corps of Engineers)

\$1.5 to \$2 million Construction (Corps of Engineers)

- *(Intermediate to Long Term)* An extensive geotechnical program of sampling, testing, and analysis for the El Reparto landslide similar to that described for the El Berrinche landslide above would cost approximately \$150,000. Active construction measures to prevent future movement and stabilize the landslide would be \$0.75- to \$1.0-million.

\$150,000 Analysis (Corps of Engineers)

\$ 75 to \$1 Million Construction (Corps of Engineers)

- *(Short to Long Term)* In addition to specific areas that have been identified in Tegucigalpa, there may be other areas that might be considered for relocation or non development based on the incidence of shallower debris flows that were triggered by the storm, and destroyed property and infrastructure within the city. An inventory map of all landslides that occurred within Tegucigalpa coupled with a GIS-based analysis involving data layers, such as geology and Hurricane Mitch precipitation, may result in the delineation of areas of high susceptibility. Judicious planning of future use would result in saving people and property during future extreme climatic events such as Hurricane Mitch.

\$300,000 to \$350,000

(U.S. Geological Survey)

- *(Short Term)* The city of Tegucigalpa should prohibit any reconstruction within one block (approximately 100 meters) of the river until further floodplain studies are conducted to better define flood risks.

(City of Tegucigalpa)

- *(Short Term)* It is imperative that the Rio Choluteca channel capacity be increased as soon as possible. This is required to ensure free-flowing water through Tegucigalpa for water quality purposes as well as to restore adequate conveyance or channel capacity for high-water flows.

Removal and transport of sediments to higher ground outside of the floodplain should be accomplished. Sediment removed from the channel proper should not be placed in the floodplain areas immediately adjacent to the channel. The low-lying areas adjacent to the channel are important flow-conveyance areas, and should not be filled with excavated materials
(City of Tegucigalpa)

- (Short to Long Term) Hydrologic and hydraulic modeling of the Tegucigalpa River system should be accomplished, to include installation of a streamflow gaging station/floodwarning network with realtime data transfer capabilities. Determination of Hurricane Mitch peak discharge (indirect measurements) for the Rio Choluteca and its major tributaries would accompany this effort. This work should be conducted in the short-term as flood evidence (high-water marks, etc.) can fade quickly. Accuracy of the computations is dependent on accuracy of surveyed flood marks and peak-flow channel geometry. This information also is required for development of the initial stage-discharge relation for proposed streamflow gaging stations. The information obtained from the indirect measurements would allow for determination of design flood flows and corresponding flood profiles through the City. With this information, neighborhoods susceptible to flooding can be delineated, flooding recurrence intervals can be determined, and design discharge velocities can be computed which would aid in design of flood channels and other hydraulic structures, including redesign of existing hydraulic structures that may be causing constriction of the flow. The realtime streamflow gaging station network also would allow for adequate warning of downstream population during flooding, and better management of reservoirs above population centers, particularly Tegucigalpa. A rainfall-runoff model will be developed that with flood prediction capabilities on the basis of predicted rainfall depths and intensities.

Hydrologic Modeling

(Incl. Indirect Measurements) \$500,000 (U S Geological Survey)

Hydraulic Modeling

(Floodplain Delineation) \$100,000 to \$250,000 (Corps of Engineers)

Streamflow Gage Network \$750,000 (U S Geological Survey)

- (Intermediate Term) Consider purchase and removal of damaged buildings (especially the National Gymnasium) across from the El Berrinche landslide to increase channel capacity
(City of Tegucigalpa and Corps of Engineers)

- (Intermediate to Long Term) Construction of upstream reservoirs in strategic locations also would be beneficial to alleviate flooding problems in Tegucigalpa. Portions of these reservoirs would be reserved for storage of floodwaters during flooding, which would alleviate flooding problems in Tegucigalpa. If needed, water supply/hydropower/recreation features could be incorporated in a multipurpose reservoir system. Hydrologic and hydraulic investigations would be required to determine the effectiveness of the system.

\$200 to \$500 million per reservoir (Corps of Engineers)

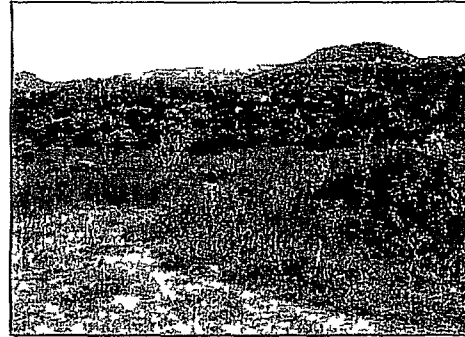
Evaluation of Proposed Housing Sites

El Ingles

General This is one of two proposed housing sites. It is located approximately 8 kilometers south of Tegucigalpa on a ridge and adjoining low slope.

Flooding The site is located in an upland area and, therefore, is not susceptible to widespread flooding. Local drainage should be considered, however. Relocated population should not build or encroach on the channels adjacent to the relocation site.

Landslides The site is underlain by volcanic rock. There are no geologic hazards at the site. The site itself has little landslide hazard potential due to very low slopes; however, the access road to the site is highly vulnerable to debris flows. Seven debris flows triggered by the rain from Hurricane Mitch were observed both above and below the road, with debris encroaching onto the road, removing portions of the outer road edges.



The El Ingles site has no flooding or landslide problems

Water Supply Due to the local relief, the underlying volcanic rocks, and the non-perennial nature of the adjacent Quebradas El Aguila and El Ingles, groundwater is not considered capable of being a significant source of water for this site. Yield is expected to be less than 30 gallons-per minute (gpm) for a well drilled to a depth of at least 100 m, and multiple wells may interfere with each other, as discussed for the Las Trancas site. It is anticipated that water will have to be piped to the site from a surface source, possibly the Rio Sabacuante, or trucked to the site from some other source. Prior to delivery of any water by trucks, however, the road leading from the highway to the site will have to be repaired in several areas where it is undermined by slides. Cost of water system consisting of a small surface impoundment, transmission line, ground storage tank, and distribution system is estimated to be \$6 million.



Access to the El Ingles site is via a very poor 5 km long road characterized by numerous landslides

Sanitation Latrines are not suitable on the very thin soils overlying the volcanic rock on this site. An oxidation pond located downhill is considered to be the best alternative. Cost for an oxidation pond and sewage collection system is estimated to be \$10 million.

Environmental Development of this site will remove the existing vegetation and increase the runoff from the site due to construction of impervious surfaces. Additionally, due to the reliance on wood for fuel, the increased population in this area can be expected to utilize the forested areas in the vicinity as a source. This practice will further increase runoff in the watershed and increase flooding downstream. Unless sanitary sewage is treated, water quality of nearby streams will be degraded.

Site Access The site is located approximately 5 km off the main highway. The access road is in very poor condition and would require extensive upgrading. There are numerous debris flows along

both sides of the five kilometers of road, which connect the site to the main highway. At several locations these debris flows have partially undermined the road. Possible future deforestation associated with the proposed settlement could aggravate the slope stability problems.

\$1.5 to \$3 million

(Corps of Engineers)

Las Trancas (Nueva Capital)

General The second relocation site is located approximately 2 km southwest of the Laguna de Pedregal west of the City of Tegucigalpa. The site is located near the proposed location for the new Tegucigalpa airport.



The Las Trancas site in Tegucigalpa

Landslides The low hillslope gradient and the thin soil preclude the occurrence of landslides. Slopes at the site range from 5° to 15° and are armored with basalt and/or andesite with very little soil. There was no evidence of preexisting landslide topography there, hence landslide hazard at this site is low to nonexistent.

Flooding The site is located in the upland area and is considered adequate from a flooding perspective. Structures that allow conveyance for localized drainage will be required. Population should not be allowed to encroach on channels that drain the Laguna de Pedregal.

Water Supply Due to the high elevation, fractured nature, and limited extent of the basalt flows located west and southwest of Tegucigalpa (which includes the Las Trancas site), wells in these areas generally yield less than 15 gpm each. Also, multiple wells at the Las Trancas site would interfere with each other, further reducing the yield per well. Therefore, groundwater is not considered to be capable of being a significant source of water at this location. Most, if not all, of the water will have to be trucked or piped to the site from other sources. It is recommended that the feasibility of piping water from the Laureles water treatment plant, located approximately 5 kilometers from the Las Trancas site, be investigated. Cost of a water system consisting of transmission line from the treatment plant, 500,000-gallon ground storage tank, and distribution system is estimated at \$5 million.

Sanitation An oxidation pond located downhill is considered to be the best alternative. Cost of an oxidation pond and sewage collection system is estimated at \$8 million.

Environmental Development of this site will remove the existing vegetation and increase the runoff from the site due to construction of impervious surfaces. Additionally, due to the reliance on wood for fuel, the increased population in this area can be expected to utilize the forested areas in the vicinity as a source. This practice will further increase runoff in the watershed and increase flooding downstream. Unless sanitary sewage is treated, water quality of nearby streams will be degraded.

Site Access Access to this site is via a series of neighborhoods located on the western side of Comayagüela and north/northwest of the airport. Roads to the site are generally in poor condition.

The following cost factors can be used for road construction if upgrade to the roads is considered due to the proposed population increase with Las Trancas

Road Type	Repair Cost (\$ / km)
2 lanes (paved, 4 m/lane)	520,000
2 lanes (unpaved, 4m/lane)	500,000
1 lane (paved, 4m/lane)	260 000
1 lane (unpaved, 4 m/lane)	250,000

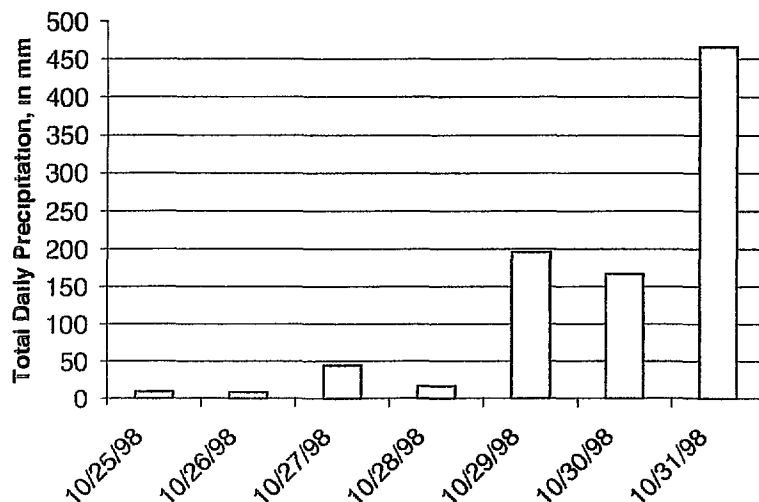
Choluteca

General

The City of Choluteca lies in the southern part of Honduras near the Pacific Ocean (Gulf of Fonseca) within the Department of Choluteca. The City of Choluteca contains approximately 113,000 people, and total population in the Department of 377,241 as of 1997. The City of Choluteca is located primarily along the left bank of the Rio Choluteca, which drains an area of approximately 8 150 square-kilometers (3,143 square-miles). Average rainfall in the basin is 1,300 mm (51 inches) producing a mean annual flow of 84 cubic-meters per second (2,967 cubic feet per second).

Description of Problem

During the period of 27 – 31 October 1998, Choluteca received 893 mm (35 inches) of rainfall associated with Hurricane Mitch, most falling on the 29th – 31st. The heavy rainfall caused extensive flooding, erosion, and sediment deposition in the Choluteca area. In addition to the loss



of many bridges and roads, it is estimated that 4,400 homes were destroyed and 6,600 homes damaged in the Department of Choluteca.

Landslides

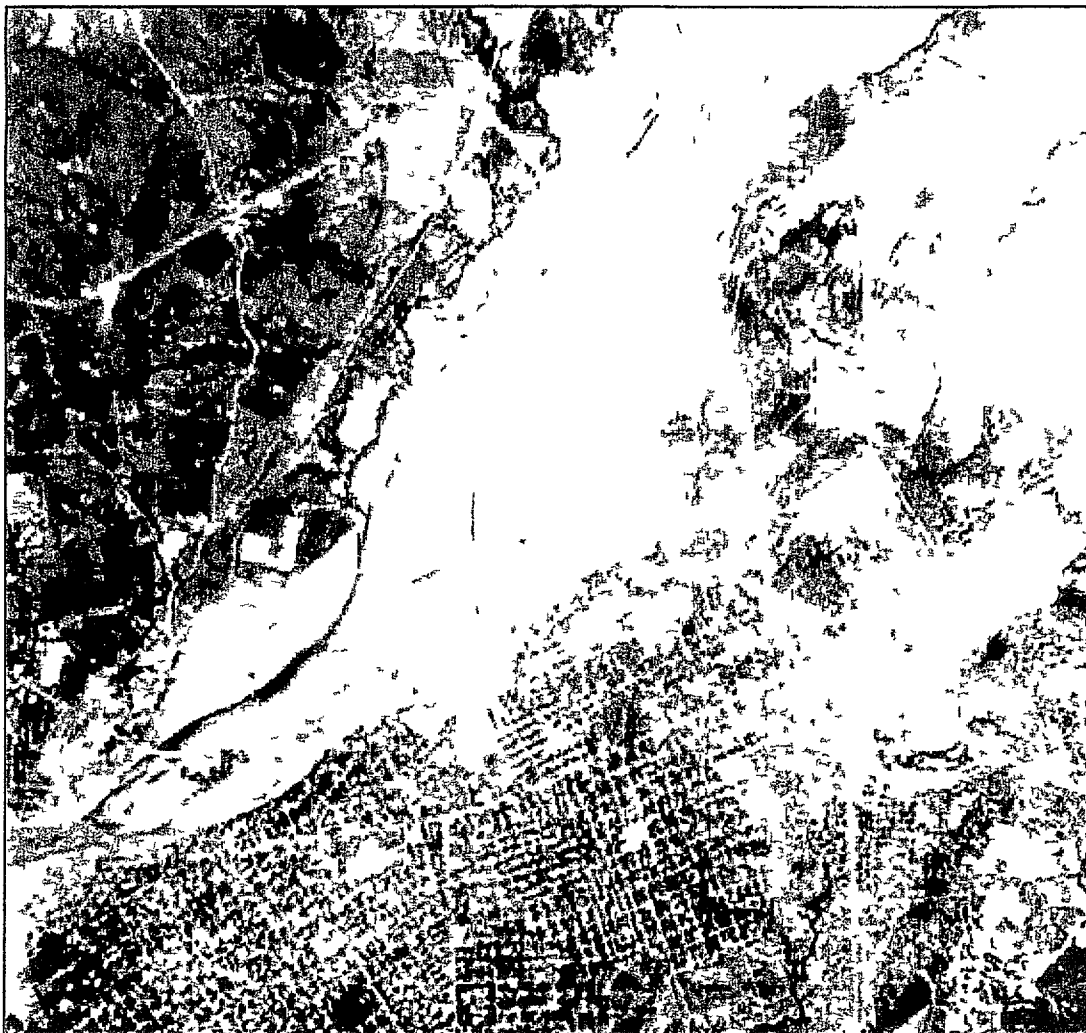
Landslide concentrations triggered by Hurricane Mitch in southern Honduras were the highest observed in Honduras. Sediment produced by

landslides may have provided a significant influx to the Rio Choluteca floodplain. Sediments contributed by landslides adjacent to the river basin may continue to provide high sediment loads.

during future flood seasons. The contribution of sediment to the Rio Choluteca has not yet been completely assessed.

Flooding

According to local authorities, the Rio Choluteca peaked sometime Friday evening, 30 October 1998. Floodwaters remained high for several days causing substantial lateral scour of channel margins and aggradation of sediment in the Rio Choluteca as well as the surrounding floodplain. In Choluteca there were 260 registered deaths, 400 persons missing, and approximately 2,500



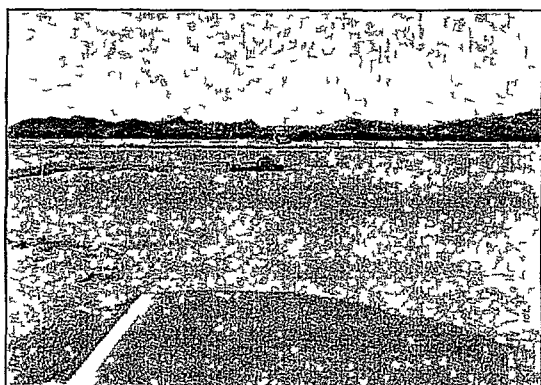
Clearly visible in this view of Choluteca is the extremely wide floodplain

homes destroyed, primarily along left bank of the River. Local authorities also estimate approximately 2-3 meters of sediment deposition throughout the Rio Choluteca channel. Two bridges cross the Rio Choluteca in the vicinity of Choluteca, and both were extensively damaged. The newer bridge located upstream of the city and built by the Japanese, lost both its right and left embankments when severe lateral erosion of channel boundaries occurred. The older bridge located in the city of Choluteca, and built by the Army Corps of Engineers, lost a substantial

amount of its right approach embankment. Temporary access has been restored to the Corps of Engineers bridge.

Mitigation Measures

- *(Intermediate Term)* Both bridges should be re-built with provisions for additional flow relief openings for the safe passage of flood flows. Both bridges provide a clear span over the low



The entire left abutment of the bridge north of Choluteca was destroyed

flow channel only and provide little or no overbank flow capacity for flood flows. When the river floods, water can back up on the upstream side of the bridges, such that when the embankment is overtopped, the difference between the upstream and downstream water surface (head differential) is so great that the embankment erodes and fails. Hydrologic and hydraulic flow modeling should be accomplished in order to determine the proper amount and location of flow relief. The estimate given below is based on additional relief

bridges of 150 – 450 meters in length with a total flood plain distance to be re-built of 1 200 meters. The relief bridge location and width should be based on hydrologic/hydraulic modeling.

<i>Hydrologic/Hydraulic Flow Modeling</i>	<i>\$150,000 to \$350,000</i>	<i>(Corps of Engineers)</i>
<i>Construction Costs</i>	<i>\$3.5 to \$8.0 Million</i>	<i>(Corps of Engineers)</i>

- *(Short Term)* It is recommended that the area near and riverward of the cemetery located on the south side of town not be re-built. This area is located in the active flow area of the Rio Choluteca floodplain. *(City of Choluteca)*



The area of Choluteca near and riverward of the cemetery should not be rebuilt

- *(Short Term)* Construction of a realtime streamflow gaging station upstream of Coluteca on the Rio Choluteca. Conduct indirect measurement of peak flow, and develop stage-discharge relation utilizing channel geometry and the standard-step method.

\$60 000 to \$100 000 (U S Geological Survey)

- *(Long Term)* For those low-lying areas of Choluteca which were flooded, filled with sediment, but not destroyed a likely solution may be construction of a levee or floodwall to protect these areas. A levee may be feasible due to the relatively small area to be protected, minimal

infringement on the floodplain, and the absence of significant interior drainage to account for Hydrologic hydraulic, geotechnical, and structural studies will be required to determine levee height, alignment, length and structural design

\$560 000 to \$960 000 Feasibility/Design Analysis

(Corps of Engineers)

\$7 to \$12 Million Construction

(Corps of Engineers)

- (Short Term) It is not recommended that the Rio Choluteca be dredged or excavated as a measure to reduce flooding. A tremendous amount of sediment has been introduced into the river system at Choluteca and the watershed upstream. For many years to come, this sediment will be moving through the channel and overbank during high-water events and will likely negate any local efforts at sediment removal. The only exceptions to this recommendation is for the removal of aggregate material for construction purposes, or if needed, localized dredging to re-align the low-flow channel.
- (Intermediate Term) Further analysis of aerial photography taken of the area will be needed in order to evaluate the production of sediment by landslides, the movement of sediment to the floodplain, and extent of flooding and areas inundated by Hurricane Mitch floodwaters (that should not be redeveloped). Such an evaluation would be accomplished from an inventory of landslides using aerial photography of the drainage basins that affect the floodplain of the Rio Choluteca near the city of Choluteca. With digitization to a GIS platform, areas and volumes can be calculated and the sediment production due to landslides estimated. Such an estimate of sediment production and the spatial variation of the sediment volume may be critical to the placement of any control structures that may mitigate the river's future flooding potential. The cost for the landslide inventory and flood inundation GIS analysis would be \$400,000 with \$500,000 for information, data transfer, and training of personnel from the local agencies.
\$400 000 to \$500 000 (U S Geological Survey)

Evaluation of Proposed Housing Sites

Nueva Choluteca

Flooding The absence of river-transported sediment reveals that the site is not on the active nor ancient flood plain, hence flooding due to high river flows is unlikely. We anticipate that a local drainage system for the planned development will be required.

Landslides The absence of slopes of over 5° precludes landslides, which would pose any significant hazard to the site. A low hill about 100 m to the north of the site has slopes of greater than 20°, but it is far enough from the housing area that any landslide that might form on the hill will not present a threat to the residences. In addition, there was no evidence of any slope failure present on the hill.

Water Supply Water can possibly be provided at this site by wells. However, a test well is recommended for confirmation. A hill located immediately north of the site is probably volcanic and indicates that bedrock beneath the site is at a



Site work has begun at Nueva Choluteca

shallow depth. A well constructed in bedrock in the Choluteca area produces less water (generally about 30 gpm) than a well producing from the alluvial aquifer. Wells producing from the alluvial aquifer in the Choluteca area generally pump in the 160 gpm range (some of the higher producing alluvial wells are reportedly located on the west approach to Choluteca). If sufficient production cannot be obtained from wells at the site, it is recommended that additional wells be drilled approximately 2 kilometers either north or east of the site. The cost for wells at this site is estimated to be about \$20 000 each. Assuming alluvial wells can be drilled at or near the site at least three wells would be required. Cost for a 300 000-gallon ground storage and water distribution system is estimated at \$4 million.

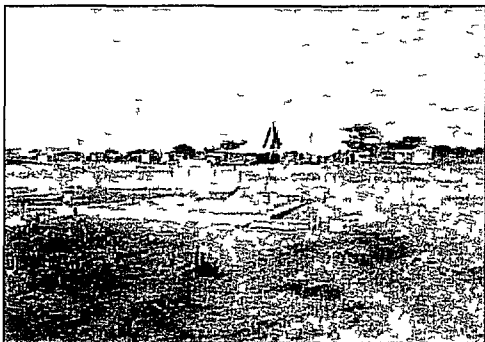
Sanitation An oxidation pond is being planned for this site. This option is recommended as a minimum. Cost for an oxidation pond and sewage collection system is estimated at \$6 million.

Environmental Development of this site would have limited environmental impacts. Effluent discharged from the oxidation pond would have localized adverse water quality impacts.

Site Access Access to the site is excellent.

Nueva Eden

Flooding This site is not on the active or ancient flood plain and is less susceptible to river inundation. Poor drainage from improper site development may cause localized drainage problems. These may be aggravated by the proposed housing development. Adequate site grading and storm drainage should be provided.



Construction has commenced at Nueva Eden

Landslides As in the case of Nueva Choluteca, this site is on practically flat ground, hence no landslide hazard is perceived to be present here.

Water Supply Water for this site can probably be provided by wells producing from the alluvial aquifer. Such wells should produce about 160 gpm. However, analysis of water produced from the shallow alluvial aquifer in and near the urban area of Choluteca has shown that many are contaminated with bacteria. Another possible source of pollution at this site is leachate from the adjacent dump. It is recommended that any wells drilled at this site be drilled as far as possible

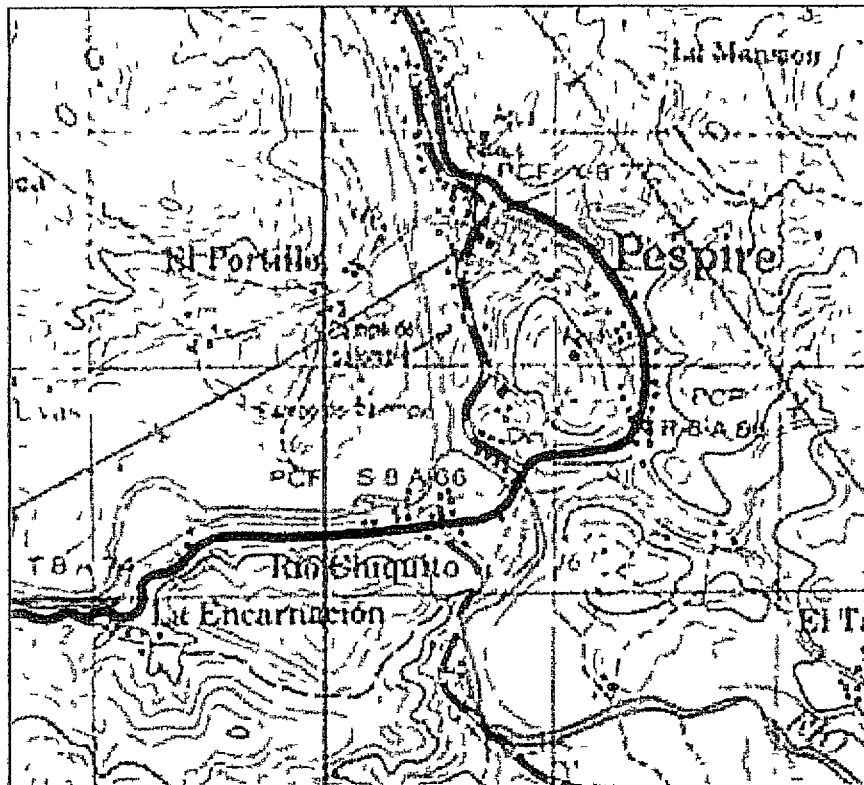
from the dump or any known areas of bacterial contamination. A minimum of two wells are needed for this site, with the cost approximately \$15 000 each. Cost for a 20,000 gallon ground storage tank and water distribution system is estimated at \$4 million.

Sanitation An oxidation pond is being planned for this site. This option is recommended as a minimum. Cost for an oxidation pond and sewage collection system is estimated at \$7 million.

Environmental Development of the site would have limited environmental impacts. There was no watercourse nearby to receive effluent from the oxidation pond. Design of the treatment system should consider environmental effects.

Site Access Access to the proposed site is through existing municipal roads and is deemed adequate

Pespire



General

The city of Pespire is located along the left (east) bank of the Rio Nacaome. The city is in the Department of Choluteca, which in 1997 listed its population as 377,241. Housing losses in the Choluteca Department were reported as 4,400 homes destroyed and 6,600 homes damaged.

Description of Problem

Flooding from the Rio Nacaome and Rio Chiquito, which enters the Rio Nacaome immediately downstream of Pespire, caused extensive flooding, destruction of homes, and sediment deposition in the city following Hurricane Mitch. Reported rainfall amounts were 893 mm (35 inches) in downstream Choluteca and 254.1 mm (10 inches) in upstream Tegucigalpa.

Landslides

Although landslides are evident throughout this area, no landslides directly affected the town of Pespire

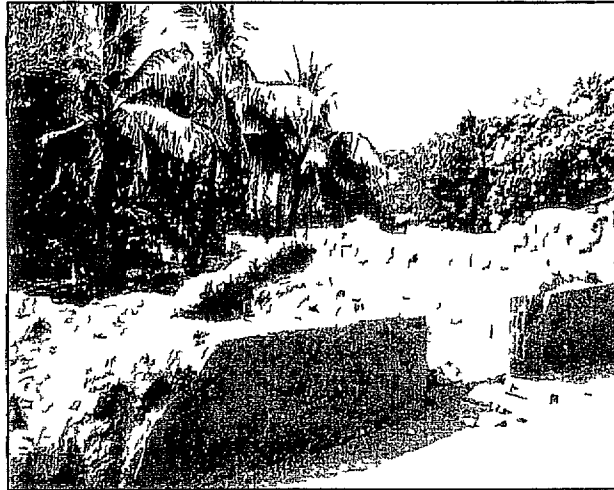
Flooding

Extensive flooding and sediment deposition occurred in low-lying areas of Pespire along the Rio Nacaome and Rio Chiquito

Mitigation Measures

- *(Short Term)* It is recommended that permanent markers or signs be erected in the city which clearly indicate the limits and depth of flooding which occurred following Hurricane Mitch. These markers would serve as a daily reminder as to the limits of the Rio Nacaome floodplain during severe storm events

\$20,000 to \$50,000



Sediment deposition was severe in Pespire

(Corps of Engineers)

- *(Intermediate Term)* It is recommended that hydrologic/hydraulic modeling be accomplished to delineate the lateral limits of the floodplain in Pespire. This would allow limits of the floodplain to be determined for storm events having differing probabilities of occurrence (i.e., 10% chance in any given year, 1% chance in any given year, etc.). It also is recommended that a realtime streamflow gaging station be constructed upstream of Pespire on the Rio Nacaome. An indirect measurement of peak discharge and development of a stage-discharge relation would accompany the streamflow gaging station.

Hydrologic Modeling (Incl. Streamflow gage and indirect measurements)

\$150,000 to \$200,000

(U.S. Geological Survey)

Hydraulic Modeling

\$50,000 to \$150,000

(Corps of Engineers)

- *(Short Term)* It is recommended that those areas closest to the river which were destroyed during the flood not be re-built. These flat areas showed evidence of extremely high velocities and flood depths, and as an active part of the floodplain should not be re-inhabited.

(City of Pespire)

- *(Short Term)* Those housing areas located on the lower slopes of Pespire and damaged by the flood may be repaired/rebuilt. These areas should expect to be flooded periodically, but the flooding should occur infrequently.

(City of Pespire)

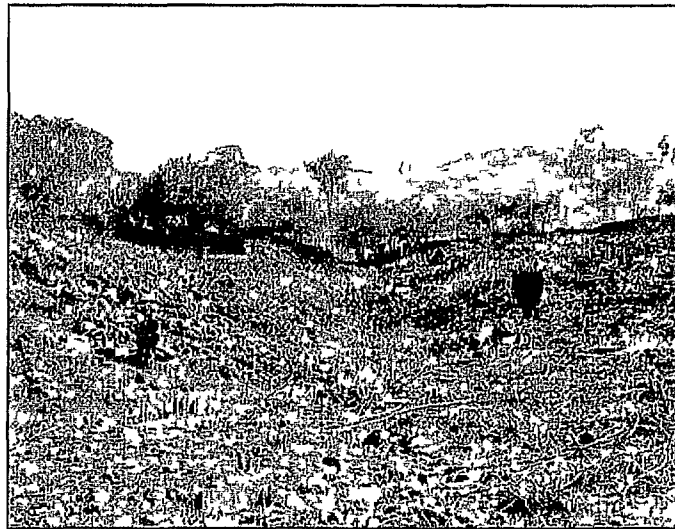
- (Short Term) It is not recommended that any dredging of the river channel be accomplished at Pespire

Evaluation of Proposed Housing Sites

Pespire

Flooding The lowest point of the proposed site is approximately 2 meters higher than the maximum flood stage of the Rio Chiquito. Hence, it is unlikely that flooding due to high-river flow will occur. The site is relatively steep and will require a local drainage system to prevent both erosion and localized flooding.

Landslides The site encloses a small and steep ridge (sideslope valley) watershed system. Topographic convergence and the steep slope causes approximately one third of this site to be susceptible to debris flows. Moreover, small ($<50 \text{ m}^3$) debris flows were observed in the upper reaches of the site, but they seem not to have advanced more than 10 m downslope. It is recommended that the upper reaches of this watershed remain off limits to livestock and irrigation. The Rio Nacaome at Pespire appears to have little influx of sediment produced by landslides. Therefore, we deem it unnecessary to analyze landslide contributions to the sediment production in this area. This proposed housing site is located adjacent to a cemetery on a hillside overlooking the confluence of the Rio Chiquito with the Rio Nacaome. The only geologic hazards present at the site are some small debris flows on the slope above the north side of the site. It is advised that housing not be constructed near the base of this slope.



The proposed housing site at Pespire is located above the floodplain

Water Supply Local groundwater is not considered to be a reliable source of water for this site. However, the local authorities plan to provide water from the same source that supplies Pespire. This source is located approximately 6 kilometers to the southeast at El Tablado, and consists of two wells drilled in an alluvial aquifer located at the junction of Rio Baire and Rio Sacamil. The only cost for water at this site is that required to connect to the Pespire system and install distribution lines. Estimated cost is \$500,000.

Sanitation An oxidation pond is being planned for this site. This option is recommended as a minimum. Cost for an oxidation pond and sewage collection system is estimated at \$3 million.

Environmental Except for the adverse water quality effects of sewage effluent, development of this site should have limited environmental impacts.

Choloma

General

The City of Choloma is located in the western portion of the Sula River Valley, approximately midway between Puerto Cortes at the northern end of the valley, and Villanueva at the southern end of the Valley. The Sula Valley is a major contributor to the overall Honduran economy. Agriculture and industrial production in the Sula Valley represents approximately 50 percent of the Honduran Gross Domestic Product (GDP). The Valley also is responsible for approximately 40 percent of Honduras's total agriculture production, the Country's most important economic sector. The City lies within the Cortes Department, which is the second most populated department in Honduras. In 1997, population of the department was 846,098.

Description of the Problem

During the period 25-31 October 1998, 565.5 mm (22.3 inches) of rainfall fell at the town of Tela, located on the north coast of the Country. The heavy rainfall caused widespread flooding throughout the Sula Valley. In the Choloma area, levees constructed by the Sula Valley commission overtopped and breached in several locations along the Rio Chamelecon, resulting in high velocity flows and destruction of housing. Landslides were not a major factor in Choloma.



Landslides

Landslides were not an issue at Choloma due to its location in the alluvial plain of the Sula Valley.

The levee along the Rio Chamelecon overtopped and breached in several locations.

Flooding

Flooding at Choloma was part of the overall flooding that occurred throughout the Sula Valley. The Sula Valley lies at the confluence of the largest rivers in Honduras, including the Rio Chamelecon with a drainage area of 4,250 square kilometers (1,639 square miles) and the Rio Ulua with a drainage area of 21,700 square kilometers (8,368 square miles). These drainage basins receive over 1600 mm (60 inches) of rainfall per year. Due to the large drainage into the

valley, and the flat, alluvial nature of the Sula, most of the Valley is susceptible to frequent, widespread flooding. Additionally, at Choloma, the Choloma River enters the Sula Valley from the west providing an additional source for flood flows.

Mitigation Measures

- *(Short Term)* It is recommended that the levees that were breached in the area of Choloma be repaired as soon as possible, preferably prior to the next rainy season.
(Sula Valley Commission)
- *(Short Term)* Both levee breaches observed were at locations where small communities were present. Because a levee breach is a violent occurrence, characterized by high velocity flow and extreme sediment movement, the potential for death and destruction is greatest in the area immediately adjacent to the breach. For this reason, the levee should be re-built such that the height and strength of the levee is strongest at those locations where communities are located immediately adjacent on the interior side. It appeared that at Choloma, the levees were the lowest and weakest at the locations where the communities were located.
(Sula Valley Commission)
- *(Long Term)* Due to the large size, and economic importance of the Sula Valley to Honduras, it is recommended that any proposed Civil Works for Choloma be a part of an overall flood control plan for the entire Sula Valley. This plan may contain provisions for upstream dams and reservoirs to store flood waters and sediment, a system of levees to protect key locations, and channels and floodways to efficiently pass flow. The problem is so large that a long-term, comprehensive approach to mitigating the impacts of flooding within the valley.
- *(Intermediate Term)* Most structures in the Choloma area, and particularly those areas closest to the Rio Chamelecon, are constructed on the natural grade of the land. Since this entire area is in the floodplain and subject to periodic and frequent inundation, it is recommended that new construction be elevated 1-2 meters above the floodplain. This will greatly mitigate the loss of property and life when flooding occurs.
(City of Choloma)

Evaluation of Proposed Housing Sites

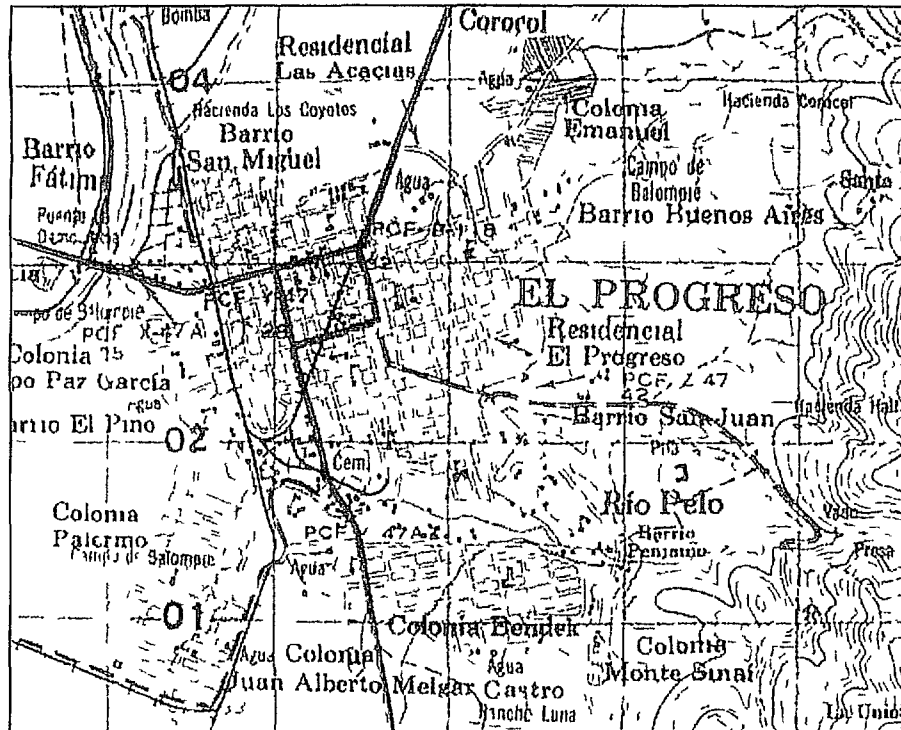
No housing sites were proposed or evaluated at Choloma.

El Progreso

General

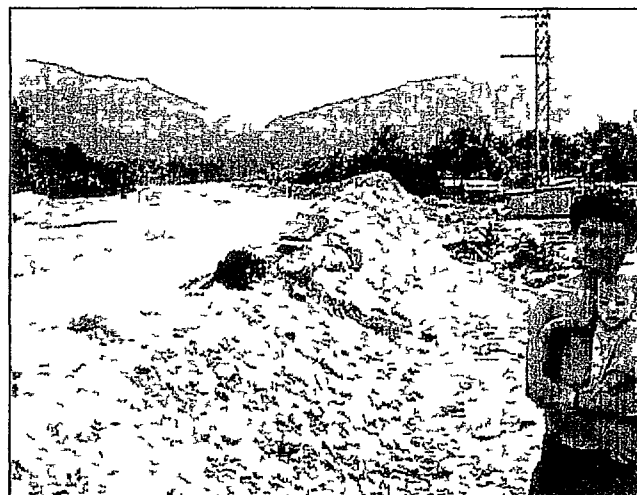
El Progreso is in the Yoro Department that had a population of 435,155 in 1997. The municipality is located at the confluence of the Rio Pelo and the larger Rio Ulua. Within this department Hurricane Mitch destroyed 1,760 homes and damaged 2,640. The Rio Pelo and the Rio Corocol run through town but the Rio Corocol does not converge with a larger channel. Instead, it empties into an area within the town.

limits The Rio Pelo watershed area is approximately 20 km², and the headwaters of the Rio Pelo provide approximately 60% of the city's potable water, the remaining 40% comes from water wells. Flooding associated with the Rio Pelo caused spatially variable erosion and deposition that damaged or destroyed hundreds of homes within the municipality. Relocation sites for the displaced residents were limited by the extensive private land holdings surrounding the municipality.



Description of Problem

The Rio Pelo, and the much smaller Rio Corocol produced flooding in the municipality. The Rio Corocol caused shallow flooding (<0.30 meters) but did not cause extensive damage. However, the Rio Pelo widened its channel by as much as 200 meters, and it produced up to 3.5 meters of bed aggradation. Sedimentation and the fate of sediment are the immediate issues that need to be addressed here. Local engineers estimate the sediment accumulated in the river basin at 250,000 m³.



Sediment deposition along the Rio Peto in El Progreso is so severe that the channel is now elevated approximately 15 meters above the floodplain

Landslides

El Progreso has been the site of tremendous sediment influx from the Rio Pelo. Part of this sediment has been derived from the preexisting river channel; however, numerous landslides are present in the Montana Mico de Quemada.

Flooding

At the confluence with the Rio Ulua, 3 meters of fine sand was deposited on nearby homes. Two kilometers upstream, 117 homes were damaged or destroyed by fast moving floodwaters and sedimentation. The sedimentation here caused the channel bed rise 1.5 meters above the floodplain. The flow in the channel is confined by a hastily built levee, hence the present river surface is higher than the present living areas of homes along the channel. At 4 km upstream the channel widened by more than 200 meters, and the concurrent lateral erosion undermined roads and about 90 homes, another 260 were damaged or destroyed. At 7 km upstream, the Mitch flood destroyed most of the municipal aqueduct.

Mitigation Measures

- *(Short Term)* If landslides were responsible for a significant portion of the sediment load supplied to the Rio Pelo from Hurricane Mitch, airphoto mapping and analysis can assess the volume and distribution of the sources. This knowledge will allow estimation of how much sediment remains in the watershed and is likely to be remobilized in future storms as well where to emplace any diversion or retaining structures that might be used to modify future flow of the Rio Pelo. Airphoto mapping and analysis will cost \$200,000. Data and information transfer will cost \$50,000.
\$250,000 (U S Geological Survey)
- Dredge the channel and transport the sediment to upland sites or use it for reconstruction. Reintroducing the sediment into the river system downstream may cause local aggradation and increase the likelihood of downstream flooding.
Assumed 250,000 m³ of material
\$1 to \$2 million (Corps of Engineers)
- *(Short Term)* Construction of a streamflow gaging station is constructed upstream of El Progreso on the Rio Pelo. An indirect measurement of peak discharge and development of a stage-discharge relation would accompany the streamflow gaging station.
(Streamflow gage and indirect measurements)
\$80,000 to \$100,000 (U S Geological Survey)
- *(Intermediate Term)* Currently, flow coming off of the mountain flows down city streets and through neighborhoods outside of established channels. The construction of a low wall or berm on the northwestern side of El Progreso would help divert and channel floodwaters into the established channels to the Rio Ulua.
\$50,000 to \$150,000 (Corps of Engineers)

- *(Short to Intermediate Term)* Those areas of the floodplain where active flow destroyed homes should be evacuated. This is particularly true in areas along the Rio Pelo where the channel is perched above the surrounding flood plain. *(City of El Progreso)*
- *(Intermediate Term)* Install channel bank protection in some areas to arrest the recent and present lateral riverbank erosion. Gabions are assumed to be used for bank protection. *\$80,000 to \$160,000 (Corps of Engineers)*
- *(Long Term)* Evaluate the potential for large landslides in the head water areas of the Rio Pelo utilizing on-ground surveys, GIS, and air photography. *\$100,000 to \$200,000 (U S Geological Survey)*

Evaluation of Proposed Housing Sites

No housing sites were proposed or evaluated at El Progreso

La Lima

General

La Lima lies in the Cortes Department. La Lima is situated on the Rio Chamelecon between San Pedro Sula and El Progreso. Within this department Hurricane Mitch destroyed 3,300 residences and damaged 4,950.

The Sula Valley is a major contributor to the Honduras economy. Agricultural and industrial production in the Sula Valley represents 50 percent of the Honduran Gross Domestic Product and 40 percent of the total agricultural production. The major crops grown in the valley are bananas, plantains, pineapple, sugar cane, citrus, corn, and rice.

Description of Problem

Hurricane Mitch flooded the entire town of La Lima. The most severely flooded homes were located adjacent to the Rio Chamelecon. Accordingly, about 1,500 residences will be relocated to a site named Via Lima about 4 kilometers northeast of the center of town. The town is also susceptible to flooding to some degree on almost an annual basis.

Mitigation Measures

- *(Short Term)* Do not allow any reconstruction in the area from which the 1,500 homes are being relocated. *(City of La Lima)*
- *(Intermediate Term)* Require new structures have no habitable quarters on the ground floor. *(City of La Lima)*

Sanitation With the very high water table and the possible unconfined nature of the aquifer at this site, latrines are not considered to be suitable. A lift station with an oxidation pond is considered to be the best alternative. Cost for an oxidation pond and sewage collection system is estimated at \$9 million.

Environmental The existing land use in the proposed relocation site is cropland, which at the present time is idle. Changing this land use for housing will have some adverse effects normally associated with urban areas. Adequate waste treatment will prevent further degradation of water quality in the receiving streams.

Site Access The relocation site is about 4 kilometers from La Lima by way of unpaved roads. These have been continually been graded so that their elevation is below that of the surrounding land. Accordingly, they do not drain well. Some improvement will be necessary to improve drainage.

La Ceiba

General

The City of La Ceiba is located on the north (Caribbean) coast of Honduras in the Atlántida Department. In 1997 the Department reported a population of 313,187, with about 35% of that in the capital city of La Ceiba.

La Ceiba has 150 families that need to be relocated. Most are being housed in schools and classes are scheduled to start in February.

The major river in the La Ceiba area is the Río Cangrejal, but flooding damage also occurred from several smaller rivers in the area. During Hurricane Mitch, La Ceiba received 875 mm (35 inches) of rainfall from 25 - 31 October 1998. It is estimated that 1,650 houses were destroyed and 2,475 houses damaged by Hurricane Mitch.

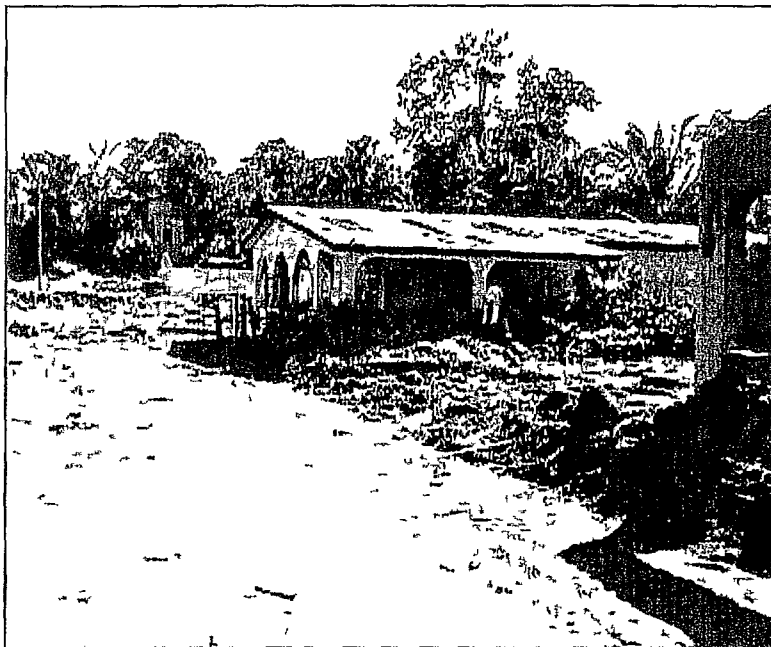
Landslides have been reported for this area but are in the mountains upstream of the towns and do not pose a direct threat to housing. The slide areas will continue to be a sediment source, possibly aggravating future flooding until the areas revegetate.

Description of the Problem

The La Ceiba area is located on the coast but just a few kilometers north of a large mountain range. Sediment from the mountains, much of it large stones and boulders, filled the rivers and caused the floodplain to greatly enlarge and the river location to move about in the floodplain (braiding and meandering), and impacting areas with erosion and sedimentation as well as flooding.

Mitigation Measures

- *(Short Term)* Provide bank protection measures to eroded areas that are encroaching on houses or roads. Realign channel to remove flow from damaged areas. Remove sediment from floodplain in damaged areas to increase channel capacity.
- *(Short Term)* Conduct an indirect measurement of peak flow on the Rio Cangrejal, and install a realtime streamflow gaging station upstream of the town of La Ceiba.
- *(Short Term)* Develop detailed GIS for the Rio Cangrejal in the vicinity of La Ceiba.
- *(Intermediate Term)* Begin debris removal to protect bridges for damage from debris accumulation and the adjacent areas from higher flood stages associated with the obstructed flow.
- *(Intermediate Term)* Repair water supply reservoir for Por Venoir.



Damaged house being renovated at Bomberos site

- *(Long Term)* Data collection and analysis to determine future flood conditions to be used to set minimum house floor elevations and floodplain areas that should not be used for housing. Investigate ways to increase capacity of water supply reservoir for Por Venoir.

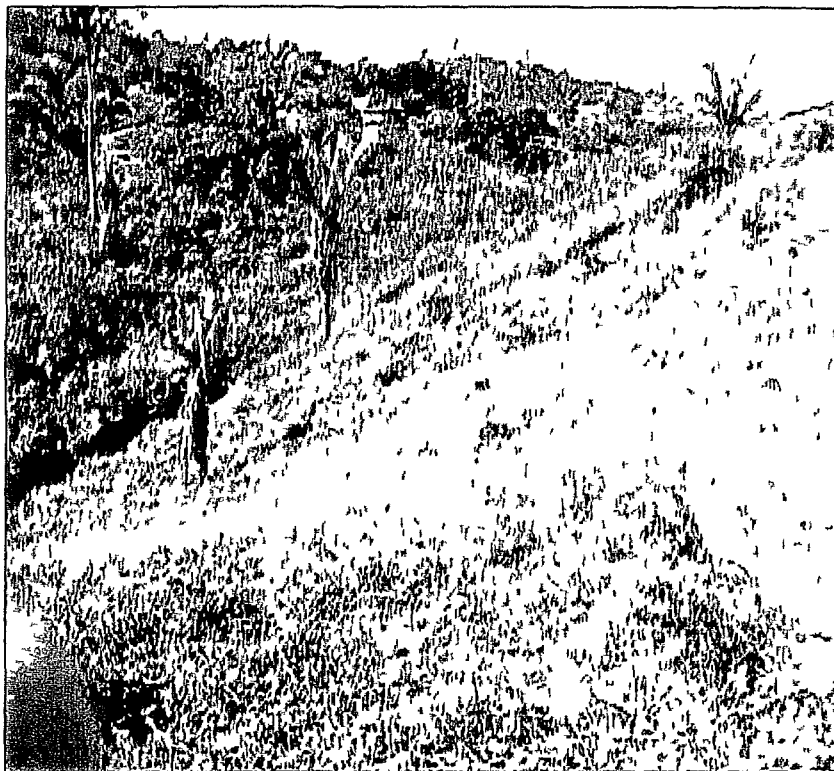
Evaluation of Proposed Housing Sites

General The following site evaluations for La Ceiba were based on meetings between the Corps of Engineers, Mayor Govzan Rivera, Tourism director Robert Hernon Leva, Community Development staff members Ligia Cerrato and Marco Aurelio Orellano, and Kent Forte, a local businessman.

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The City will furnish the land for the relocation and some materials and the tenant will have to construct his own house. The city has three locations to be used for the relocation, Colonia Canelas, Bomberos and Bufalo.

Colonia Canelas is just south of town in the hills. The site is an open area, previously deforested, with existing housing all around the area. Bomberos is a community southeast of town along the Rio Cangrejal. The flooding completely destroyed 11 homes and a textile factory. Additional homes have various degrees of damage. Some have been renovated and are in use. The Bufalo



Colonia Calenas site

community is an existing housing area with 95 existing homes and a total of 309 lots located south and west of town. Plans are for 12 foot by 14 foot frame houses on this site and there is a model home on site.

Representatives of the Corps also met with Narciso Hernandez, Mayor of Por Venor, a community just west of La Ceiba, Patrick Blake and Hector Medina of Standard Fruit, and Peter Silverman and Greg Ciuger of CEDA. Standard Fruit will donate the land to the town for the housing area. The company has previously built employee housing at adjacent sites so roads, water and electricity are readily available. The Southern Baptist Convention has pledged funds for construction, Standard Fruit will purchase the materials through their contracting department and CEDA will oversee construction. Construction has begun on the houses at this site.

Flooding Colonia Canelas, Bufalo and Por Venoir do not have any flooding concerns but the Bomberos area is adjacent to the Rio Cangrejal and had 11 homes and a textile factory destroyed. Erosion has created a cutoff through the community, and washed out part of the access road. Flooding of part of the site will continue. The limits of this area should be determined and relocation not allowed in the flood prone area.

Landslides The area is in the coastal plain so landslides are not a concern at any of the sites.

Water Supply All sites have existing public water nearby and that can be extended to the site easily. Por Venoir uses a reservoir in the mountains and sediment has reduced the capacity. Availability to provide long term supply will need to be evaluated.

Sanitation All of the sites use septic tanks or latrines for wastewater disposal at the present time and that is proposed for any new construction. The soils appear to be able to support this type of disposal.

Environmental The existing land use at all sites in La Ceiba is residential housing so the relocation will have little impact on the environment. The Por Venoir site is idle farmland that has had adjacent land previously converted to residential homesites. A seventy-five meter greenway buffer will be left between the cropland and the housing area.

Site Access Site access to the Colonia Canelas is restricted somewhat by the narrow streets through the existing residential area but is usable. Fifty-three eight meter by sixteen meter lots are available at this site. Access to the Bomberos site has a washout in the road that will need to be fixed with a new culvert and additional fill but the amount of work required is minor. Only a few lots will be usable at this site. Access to the Bufalo site is along existing roads and is good but interior streets are poor. Prior to construction of adjacent housing has a good road system in place at the Por Venoir site.

Summary and Conclusions

Rains associated with Hurricane Mitch caused extensive flooding throughout Honduras causing significant damages to infrastructure, buildings, and personal property. Additionally, the heavy rainfall triggered numerous landslides that destroyed thousands of homes. The combined effect of floods and landslides caused tremendous deposition of sediment in the river channels and in the floodplain. For many years to come. This sediment will be slowly moving through the river channels and overbank areas during high-water events. Furthermore, non-vegetated land exposed by the landslides and eroded streambanks will contribute more sediment to the rivers during subsequent rain events. Accordingly, flooding in Honduras in future years is likely to be more frequent and more severe than in the past thereby emphasizing the need to develop flood damage mitigation measures. It is imperative that measures be taken prior to the next rainy season to reduce flooding risk to the extent possible. For the long-term, however, mitigation measures need to be developed for both flooding and landslides in urban areas using a structured comprehensive multi-objective planning process on a watershed basis. On the basis of information obtained from site visits and discussions with local officials, the team recommends that the following actions be taken.

Tegucigalpa

Short Term

- Prohibit reconstruction of homes on El Berrinche and El Reparto landslides
- Regrade landslide surface and seal open cracks
- Survey landslides and monitor for renewed movement
- Prohibit reconstruction of homes within 100 meters of the Rio Choluteca
- Continue excavating sediment from the Rio Choluteca channel
- Conduct hydraulic analyses (indirect discharge measurement) of Rio Choluteca and major tributaries to determine peak discharge

Intermediate Term

- Develop a landslide inventory, GIS analysis, estimate sediment production by landslides
- Remove structures severely damaged by flooding that encroach on the Rio Choluteca channel
- Install realtime streamflow gaging station and precipitation gage network
- Conduct "indirect" peak discharge surveys and computations for selected reaches of the Rio Choluteca and its major tributaries
- Conduct hydraulic analyses to define floodplain limits and determine required capacity of hydraulic structures

Long Term

- Design and construct landslide stabilization measures
- Conduct comprehensive analysis of water resources and recommend projects for construction

Choluteca

Short Term

- Prohibit construction of homes destroyed by flooding
- Construct a realtime streamflow gaging station upstream of Choluteca
- Conduct hydraulic analyses ("indirect" discharge measurements) of Rio Choluteca and major tributaries to determine peak discharge

Intermediate Term

- Rebuild damaged bridges with additional flow relief openings
- Conduct landslide inventory, GIS analysis, estimate sediment production by landslides

Long Term

- Conduct comprehensive analysis of water resources and recommend projects for construction

Pespire

Short Term

- Install permanent markers showing limit and height of Hurricane Mitch flooding
- Prohibit reconstruction of homes in area where homes were destroyed
- Allow repair of damaged homes on the floodplain fringe

- Construct a realtime streamflow gaging station upstream of Pespire on the Rio Nacaome
- Conduct hydraulic analyses ("indirect" peak discharge measurements) of Rio Nacaome

Intermediate Term

- Conduct analysis to define floodplain limits
- Develop GIS for the Rio Nacaome in the vicinity of the town of Pespire

Choloma

Short Term

- Repair breached levee sections with increased height in vicinity of adjacent communities

Intermediate Term

- Require first floors of new construction to be elevated 1 to 2 meters above the floodplain
- Develop GIS for the Sula Valley

Long Term

- Conduct comprehensive analysis of water resources and recommend projects for construction for the Sula Valley

El Progreso

Short Term

- Dredge/excavate Rio Pelo channel
- Prohibit reconstruction of destroyed homes
- Construct a realtime streamflow gaging station upstream of El Progreso on the Rio Pelo
- Conduct hydraulic analyses ("indirect" peak discharge measurements) of Rio Pelo

Intermediate Term

- Construct a structure to divert sheetflow (north El Progreso) into established channels
- Conduct analysis to define floodplain limits
- Evacuate structures in active floodplain of the Rio Pelo
- Install channel bank protection
- Develop GIS for the town of El Progreso

Long Term

- Evaluate potential for landslides in Rio Pelo headwaters Design and construct needed mitigation measures

La Lima

Short Term

- Prohibit reconstruction of destroyed homes

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Intermediate Term

- Require first floors of new construction to be elevated 1 to 2 meters above the floodplain--Develop GIS for the town of La Lima

Long Term

- Conduct comprehensive analysis of water resources and recommend projects for construction for the Sula Valley

La Ceiba

Short Term

- Provide bank protection measures to eroded areas
- Conduct an indirect measurement of peak flow on the Rio Cangrejal
- Install a realtime streamflow gaging station upstream of the town of La Ceiba
- Develop detailed GIS for the Rio Cangrejal in the vicinity of La Ceiba

Intermediate Term

- Begin debris removal to protect bridges for damage from debris accumulation and the adjacent areas from higher flood stages associated with the obstructed flow

Long Term

- Data collection and analysis to determine future flood conditions to be used to set minimum house floor elevations and floodplain areas
- Investigate ways to increase capacity of water supply reservoir for Por Venoir

General/ Countrywide

- Capacity building
- Hydrologic modeling
- Hydraulic modeling
- Natural disaster response planning
- Stream gage network and simulation ("indirect" peak discharge measurements before rainy season)
- Stability analysis and instrumentation
- Hazard assessment
- Sediment budget including
- Landslide contribution
- Landslide hazard assessment